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INSURANCE BY INDUSTRIES.

WE recently received from the British Engineers' Association an interesting article on "Unemployment Insurance," by Mr. D. A. Bremner, O.B.E., the Director, prefaced by statistics showing the alarming position which at present exists; the unemployed on the register now being not many less than at the end of November, when they numbered over 1¼ millions. Add to this 53,000 drawing benefit for intervals of unemployment, and nearly 1½ millions in receipt of Poor Law relief, and it will be seen that this country is bearing the consequences of the Great War and the Little Peace as hardly as any in Europe.

Mr. Bremner further shows that the country's annual expenditure under the heading of "Civil Services," has a grand total of £346,000,000, as compared with £55,000,000 in 1913-14. Of this increase of 291 millions, a total of no less than 134 millions appears to be for increased cost of ordinary services unconnected with the war—an increase considerably in excess of our total expenditure for all purposes only a few years ago.

The national income estimated by Mr. Edgar Crammond has gone up from 2,400 millions in 1913 to 2,900 millions in 1922, an increase of 20.8 per cent., whereas the Exchequer expenditure has increased by 278 per cent. But the National Income in terms of commodities and services is now worth only about 70 per cent. of its pre-war value. We are therefore even poorer than the above figures indicate.

It has been pointed out frequently, and is again insisted upon by Mr. Bremner, that the only real remedy for unemployment is to increase trade and industry. But unemployment must be adequately provided for, and it can be, if it be reduced to reasonable proportions. In that case it might even be financially possible for each industry to carry its own unemployment insurance. Most certainly such a scheme is not possible in present circumstances. Even the National Insurance Fund was in debt to the Exchequer by 14½ millions in November last. Clearly, unemployment must be greatly reduced as a preliminary to any new scheme.

Mr. Bremner remarks that this may be assisted by a little reasonable re-inflation of currency and credit. The two should not be coupled too closely together, as the country's credit can be used to good purpose, without seriously inflating the currency.

In Mr. McKenna's recent speech to the London City and Midland Bank shareholders he advocated an inflation of credit and blamed the deflation policy of the Treasury for much of our trouble.

Mr. Bonar Law's recent speech and action indicate that he is aware that steps to improve the labour conditions must be taken by the State at once, and he promised State aid for any practicable schemes.

Every effort should be concentrated on bringing the problem within limits this year; and any attempt to improve the system of unemployment insurance should be postponed until better times make a sound scheme practicable. In the meantime discussion can do us no harm provided it does nothing to delay action on the main problem of increasing employment.

The advocates of insurance by industries wish to see

each industry carrying unaided the burden of its unemployment. The idea of a great industry such as engineering carrying all its own burdens without being "beholden to anybody" is attractive. The chief advantage claimed is no doubt that if the industry were carrying its own burden the industrialists would see to it that administration was effective, and inexpensive; and that there was no imposture. Certain it is that there is plenty of room for improvement under both these heads. One has only to consider the shortage of domestic servants and the numbers of women drawing unemployment benefit, to see what a gigantic imposture is possible. The cruelty and injustice of burdening every man and woman at work with the maintenance of others who prefer drawing a dole to taking the wage and maintenance which domestic service offers is obvious. No doubt insurance by industries would make it a little more difficult to secure the dole, if work were really available.

It would also, we feel sure, tend to economy in administration. Unfortunately for other reasons it is unsound and impracticable, and remedies for these two great evils must be otherwise applied. If we consider how the proposal would affect our own industry it will be seen at once that the difficulty of definition is enormous.

The electrical engineering industry embraces thousands of men drawing their wages from other industries in which they are employed to keep electrical plant in going order. The railways, for instance, employ large and increasing numbers. Electrical engineers in central stations are often employed by local authorities, and have no direct connection with the trade. It would be interesting to hear how high up the system is to extend. Would foremen, managers and travellers in the trade be included? We see no good reason why the insurance should be confined to men who work with their hands.

Then again the principle of mutual support would be lost. At present the electrical trade is recovering from a period of depression, and is perhaps less favourably situated than most others for shouldering a great burden. Obviously the great advantage of a universal State system is that the trades that are flourishing at any time can support those that are depressed. We think that the advantages of economical administration and local vigilance can be secured better by having district organisations based on areas to administer the national scheme, with the County Council or the Borough Council as the nucleus to provide offices and other services, and the Labour Exchanges reformed and reorganised to carry out the detail of administration.

We can imagine a healthy rivalry springing up between, say, Leeds and Bradford as to which had the better results. And local patriotism would have full scope. Public opinion should be educated to distinguish very clearly between a contributory unemployment insurance and Poor Law relief; and, in proportion as the insurance situation improves, the Poor Law relief should diminish. Old-age pensions should also be carefully readjusted and steps taken to avoid penalising a man who has saved in favour of one who has not. The principle of right, and no disgrace, in accepting unemployment benefit should be established, provided always that the beneficiary is genuinely unable to obtain employment at his proper trade.

In all this we are absolutely at one with Mr. Bremner, whose article should be made known as widely as possible.

Sir Charles Parsons and the I.E.E.

The meeting of the Institution of Electrical Engineers on February 15th was noteworthy, as the President remarked, in that the Council had that day conferred the highest honour within its power—the Faraday Medal—upon Sir Charles Parsons, that the distinguished inventor himself was present, and that the paper to be read by Mr. J. Rosen, his chief electrical engineer, dealt mainly with the Parsons turbo-alternators—a happy concurrence of events. The choice of the Council will meet with universal approval; the work of Sir Charles Parsons has redounded to the glory of British engineering, and has been of immeasurable value to the electrical industry throughout the world.

Mr. W. M. Selvey struck the right note when he commended the Institution for permitting the achievements of its members to be duly and openly accredited to them in its proceedings, unlike some other bodies which regarded with horror the possibility that such recognition might have an advertising value. Undoubtedly the publicity thus gained is of great value—but why should that be held objectionable? This country lives on export trade, which in turn depends upon advertisement, and the prosperity of the Institution itself is bound up with that of the engineering industry. By all means, then, let the world know what that industry can do. When so much valuable information is imparted as is contained in Mr. Rosen's paper, he would indeed be a curmudgeon who would grudge the measure of publicity which is its sole reward. To honour our own prophets is profitable.

There is, of course, another side to the question; we can recall instances in which the authors have seized the opportunity to advertise rather than to inform. But such examples are not of recent date, and the Papers Committee can be trusted nowadays to guard against the abuse of so valuable a privilege.

Piezo-Electricity.

As we have remarked on previous occasions, physical phenomena which at first sight appear to be obscure or even trivial may ultimately prove to be of immense importance to the human race; examples may be found in the Hertzian waves, radio-activity, and thermionic currents, in the electrical field. More recently the effect observed by Johnsen and Rahbek has come into prominence, and now we are able to give in this issue some particulars of the extremely interesting applications of piezo-electricity to commercial purposes which have been developed by Messrs. E. W. C. Russell and A. F. R. Cotton, at Cambridge.

Piezo-electricity, as implied by our opening remarks, is a subject of which the electrical engineer knows little or nothing. Even the name is unfamiliar; it signifies electricity produced by pressure, and is applied to a phenomenon discovered in 1880 by the brothers P. and J. Curie, which received no commercial application before the war, though it had been used for laboratory purposes. The feverish search for new methods of countering the attacks of our enemies during the war brought it into use for submarine detection, but it has remained for Messrs. Russell and Cotton to improve the apparatus and bring the phenomenon into domestic service.

A particularly interesting fact in connection with their work is that the inventors knew nothing of acoustics, had no equipment, and carried out their researches in their spare time. Nevertheless, they succeeded in ferreting out many new facts with regard to the phenomenon, and in developing patterns of apparatus which gave excellent results. Rarely does material progress accrue under such conditions; measurement is usually regarded as a *sine qua non*. All the more credit is due to these young experimenters, who have furnished a striking example of what can be done by perseverance and are to be congratulated on the skill and ability which they have displayed.

The British Industries Fair.

For a successful trade fair two conditions are necessary: first, the presence of numerous and representative exhibitors; secondly, the attendance of stock-hungry buyers. The opening on Monday last of the British Industries Fair, 1923, the ninth of the

series, showed that the first condition had been fulfilled, the high standard set by its forerunners as a display of British industrial production having been maintained, on the whole. As regards the second condition, the confident belief that the tide has turned and that British trade is about to embark upon a new period of prosperity is not the least of the many factors on which an optimistic forecast may reasonably be based.

Both the London and Birmingham sections of the Fair opened in rather unpropitious weather conditions, and the attendance on the first day was very scanty, although a number of foreign buyers paid visits. The general aspect of this year's display has much in common with that of previous Fairs, but, if anything, electrical firms are not quite so much in evidence. This applies particularly to the fittings side of the industry. One new factor is, of course, radio-telephone apparatus, and, although the exhibits of this nature are treated as side-lines, there are one or two novelties on view. This section, however, by no means compensates for the deficiency in others.

That there are absentees from the lists of well-known electrical exhibitors in both the heavy and light sections of the show has been attributed to the forthcoming British Empire Exhibition next year. It has been suggested that next season many firms will not find it possible to be represented at both shows, and that consequently the Exhibition will benefit at the expense of the Fair.

It would be a pity, however, if such a state of affairs were allowed to materialise. The yearly growth in size and popularity of the Fair testify to its usefulness, and its *raison d'être* has been justified. It will therefore be regrettable if some means are not found whereby the clashing of the two events can be prevented.

A later opening of the Fair has been advocated by some of those in authority in order to allow foreign visitors so to time their stay in this country as to enable them to cover both the Fair and the Wembley Exhibition without having to make two special journeys.

Psychology in Industry.

The processes of logic do not enable new truths to be discovered. They provide a means whereby the truth of any statement, whether old or new, can be tested. The laws of economics formulated by Adam Smith, Ricardo, Henry George, and the rest (so far as they were able to agree about them) are, when all is said and done, merely statements of experiment and observation, and the inferences we are able to draw from those statements are true when, and only when, the exact conditions of the experiment are reproduced. Tested by the rules of logic, the statement that in times of scarcity prices will rise, is seen to be true because it has happened so often that we are entitled to say that it will happen again next time. So long as we have masses of people that must be fed, so long will there be competition for the means of obtaining food. While food is scarce and mouths plentiful, so long there will not be enough to go round. All perfectly logical; all unassailable from the point of view of pure reason. Given certain premises, certain definite results, and no others, will follow from them.

But it will be observed that there is nothing here to explain why the premises are what they are. Is it necessary always to take the same conditions? Cannot some other premises be set up? Because if they can, some other results will follow from them. The old results, which we wish to avoid, cannot come from any conditions except their own.

Consideration of the present situation and of what has led up to it is useful, and enables us to see what to avoid. For this reason we welcome Lord Milner's articles in *The Observer*, though they do not appear to contain anything that will be new to readers of the Electrical Review. But permanent improvement cannot be brought about by putting square pegs into round holes and then protecting them against round pegs in round holes. Nor can we build any hopes upon a change in human nature.

The square pegs cannot be thrown away or left lying about, however. They must be fitted into square holes. This is the work of the psychologist. Although we fear that there is much groping in the dark, and not a little charlatanry about some of those who profess to practise this science, there can be no doubt that it has a considerable field of usefulness. What we have to beware of is, that "psychology," or "psycho-analysis," shall become a catchword, used by all and sundry with but the haziest notion of its meaning or implications. We have already seen "reconstruction" and "efficiency" used to death. Those to whom they mean anything go on with their work, and say little. When an idea becomes a popular craze, it is easily possible that more harm than good will be done by the unintelligent application of it. We have little patience with many of the general knowledge papers set to children with the proclaimed intention of testing their intelligence. Some that we have seen reveal nothing but a perverted ingenuity on the part of their compilers.

Selection tests, for the purpose of determining a man's suitability for particular employment, have been made in some vocations for many years, though those who are old enough to remember Mrs. Henry Wood's novels will remember that in one of them a railway accident is discovered to have been caused by the colour-blindness of the engine-driver, who in those days apparently underwent no test in this important matter. From an article by Dr. George H. Miles, the Assistant Director and Secretary of the National Institute of Industrial Psychology, published in a recent number of *Unity*, we learn that considerable progress is being made in the application of selection tests and vocational investigation to the problems of industry. By suiting the worker to his job and to the machine he has to operate, greater output and better results will be obtained with less fatigue and waste. This will cheapen production, enable the buyer to place orders, and so reduce unemployment.

Industrial psychology seems to afford an avenue towards a constructive method of dealing with the present situation, and it will be generally admitted that this avenue should be carefully explored.

The Austrian Electrical Industry.

The situation of the electrical manufacturing industry in Austria and in adjoining countries in 1922 is discussed by a German newspaper. It is pointed out that the Austrian works were adequately occupied in the first half of last year, but were less busy in the second half when activity was mainly devoted to the clearing off of old contracts accepted on deferred delivery conditions. In the autumn the rapid fall of the mark facilitated German competition in Austria and the Balkan countries, while the high wages paid rendered it no longer possible for the Austrian works to compete with Swiss and Italian rivals in certain electrical manufactures. Business in electrical machinery for mines and ironworks was limited to the completion of old orders, and no new contracts were held in prospect. The demand for electrical products in Czecho-Slovakia declined, and preference was being given to native industry in that Republic. In the Rumanian oil region the electrical requirements continue to be met mostly by German firms. Austrian exports to Hungary, as in the case of Czecho-Slovakia, are hampered by the efforts to allot native orders to the native electrical firms. In the case of Poland it is stated that the electrical needs of the mines are being mainly met by German firms now that the political difficulties and mutual embargoes have been overcome.

D

COMMERCIAL PIEZO-ELECTRICITY.

By E. W. C. RUSSELL and A. F. R. COTTON.

PIEZO-ELECTRICITY is still comparatively little known, despite the fact that it was discovered over 25 years ago by Curie. In the interval little research has been carried out in this connection until quite recently during the war, when Sir J. J. Thomson did some very wonderful work. It may be well, therefore, to describe briefly what piezo-electricity is.

Certain crystals possess the property of liberating electric charges when subjected to mechanical pressure and variations of pressure. When the pressure is applied a positive charge is obtained, and when the pressure is released a negative charge. An alternating current results from successive pressure variations. In most cases the effect is enhanced by super-imposing a constant pressure. A reverse effect is observed if piezo-electric crystals are submitted to electrical potentials, when they exhibit mechanical changes equivalent to the charges applied. In some cases the change takes the form of an expansion, in others of a twisting combined with an elongation. If the potentials applied are of an acoustic frequency, the crystal will emit sounds. *Vice versa*, when sound vibrations are applied to the crystal, currents are generated, which are their exact electrical reproductions. In other words, the crystal constitutes a microphonic generator. This article is mainly concerned with the method of application.

Crystals possessing this effect are fairly numerous, the *sine qua non* being a molecular or structural asymmetry or both. Quartz, tourmalin, feldspar, sugar, camphor, tartaric acid, and dextro-rotatory Rochelle salt are all piezo-electrically active. The most sensitive are those grown from Rochelle salt in a special way. Rochelle salt is sodium potassium tartrate, the active constituent of Seidlitz powders.

Tourmalin crystals were used by Sir J. J. Thomson during the war to measure the time effect of depth charge explosions. By the use of a cathode ray apparatus, an alternating magnetic field, and a photographic plate, he was able to draw "indicator diagrams" of the explosions similar to ordinary heat engine indicator diagrams. This achievement was described in the issue of *Engineering* of April 25th, 1919.

The cost of quartz or tourmalin and their comparatively insensitive qualities preclude their extensive use, and scientists endeavoured to find a substitute. Much pioneer research was carried out by Mr. A. McLean Nicholson, of the Western Electric Co., in America, with the result that Rochelle salt crystals, encouraged in a particular habit of growth (see fig. 1) were produced, which were remarkably sensitive. Mr. Nicholson published some papers on the subject. About June, 1920, the writers saw one of these, and were much struck by the possibilities of piezo-electricity.

It was obvious that no commercial developments could be thought of till a process could be devised for producing crystals which were standard in shape, size, and sensitivity. While it is comparatively easy to produce Rochelle salt crystals in a laboratory by complicated methods, it was found that their production on a commercial scale, accurate in size and shape to a small fraction of an inch, and at a cost not exceeding a few pence, presented serious difficulties. The writers carried out a considerable amount of research in this direction alone, and the result is a secret process which conforms to these specifications and does not require even a skilled operator. In fig. 1 A shows a crystal with a tinfoil girdle acting as one electrode, and B is the seed nucleus around which the crystal is grown. The curious formation of the crystal indicated by the dotted diagonals is known as the "hour-glass" structure; this formation is piezo-electrically very active. Experiments were then carried out to discover the best way of applying sound vibrations to the crystals. Experiments on the reverse effect have so far been too restricted to merit description.

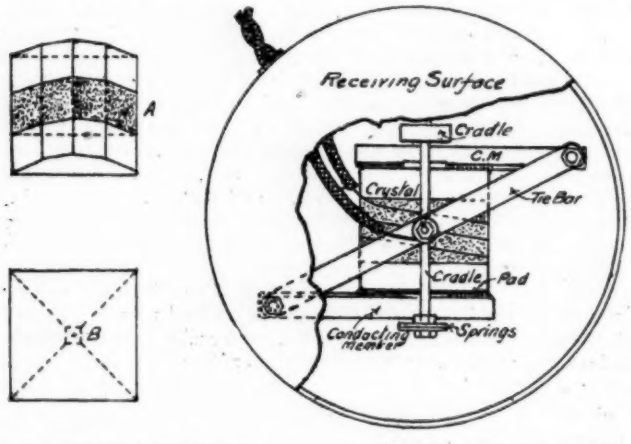


FIG. 1.—ROCHELLE SALT CRYSTALS.

FIG. 2.—PLAN, AND SIDE AND END ELEVATIONS OF RECEIVER.

At first some experiments were made on the generally accepted assumption that it was essential for the crystal to be compressed or twisted by the actual *movement* of some vibrating member. This hypothesis was found to be quite untenable. Moreover, the necessary constant pressure, under these circumstances, presented serious mechanical difficulties. Various arrangements of point pivots and knife edges had been tried and rejected, when it was discovered that if the crystal was provided with bars at its ends and secured rigidly by these bars to a receiving surface, so that no movement of any kind was possible, the arrangement was more efficient than if attempts were made to utilise the vibrations of a diaphragm.

From this it was deduced that the crystal was best affected by the passage of pressure waves through it and not by exerting a torque on it by moving members. It was then found that the greatest efficiency was obtained by passing the pressure waves through the crystal so as to produce a "torsional effect," if one may so describe a torque effected by pressure waves *without any movement*. The plates or bars which are clamped to the crystal are regarded as conductors of pressure waves, and not in any sense as vibrating members. A practical illustration will make this theory clearer. In one experiment the crystal was fixed by the conductors to a receiving surface of ¼ in. phosphor-bronze. A small

spider was allowed to walk about on the plate, and the crystal was connected to two amplifying valves. The insect's footfalls were very audible in the headphones, but by no stretch of imagination can they be said to have vibrated that plate like a diaphragm. The action was obviously one of molecular concentration, in other words, pressure waves. From the practical standpoint this absence of movement presents immense advantages, as the receiving surface can sustain much rough handling without impairing the crystal attached to it, whereas the slightest shock on a "moving" system might seriously damage it. From the point of view of sound, the absence of any movement removes one of the greatest causes of distortion which is necessarily present in all diaphragm instruments. The general arrangement of a crystal attached to a receiving surface is shown in fig. 2.

Simultaneously an application was developed in which sound was taken direct from a rotating gramophone record. Various arrangements were tried and rejected, and the following was found to be the most efficient and convenient. It is absolutely non-resonant (fig. 3). The crystal is clamped by the spring duralumin flange A between the base plates B B and the conductor C, which holds the gramophone needle. A steel point D bears on the member C, and the flange A is expanded by the nut E against the ebonite bush F let into the flange. The instrument is provided with a rubber-lined cover, shown

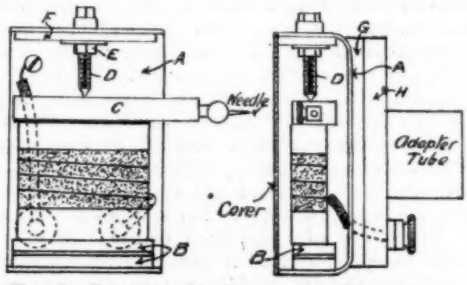


Fig. 3.—Piezo-electric Gramophone Reproducer.

in the figure. It must be made quite clear that the function of the point D is not that of a pivot, but it was found that a larger bearing surface than a point absorbed the pressure waves to a serious extent, and carried them *via* the flange to the rubber G and Erinoid back-plate H instead of allowing them to pass through the crystal.

It was found that metal conducting members in either the microphones or gramophone reproducers superimposed an undesirable "metallic" or "tinny" sound, which had to be eliminated. Conductors (by which term are meant conductors of pressure waves) made of many different substances, such as casein, were tried, but were found to be extremely inefficient. Ultimately, compressed cellulose acetate, known commercially as "celastoid," reinforced in suitable proportions with steel or brass, was found to be the most efficient and non-resonant arrangement. A reinforced conducting member is shown in fig. 4. The celastoid can be softened with acetone solution before the crystal is clamped up, which provides an excellent grip. A sheet of tinfoil is inserted between the crystal and the celastoid to act as a conductor. Between the crystal and the metal reinforcement, therefore, there is a layer of celastoid, and the metal is also covered on the other sides.

The size and volume of, and the amount of metal in, the conducting members are carefully proportioned to the absorptive capacity of the crystal used. If the member is too small, there is a loss of efficiency in transmission; if it is too large, it absorbs many of the pressure waves. The proportion of metal to celastoid is governed to a large extent by the purpose for which the instrument is intended.

In the case of the gramophone reproducer, or "sound-box," these proportions are a matter of the greatest importance, as the sound is received in the form of movement, and has to be converted into pressure waves within the bar itself before being passed into the crystal. This function is one of the principal properties of celastoid. This remarkable material possesses an astonishingly high conductivity of acoustic-frequency pressure waves, despite its extreme elasticity, and also has the property of converting movement into pressure waves. In addition to this, it exercises a modulating effect, and if proportioned correctly, will completely absorb an excess of pressure waves. That is to say, it will not tolerate any waves which may be set up by the resonance of the metal reinforcement, but will completely absorb them. Any resonance waves appear to overstep its "saturation point" and become absorbed. This is not the same as damping, since celastoid has no effect on the "legitimate" waves of the input in whatever volume they may be applied if it is proportioned correctly, but conducts them efficiently. Resonance waves, however, must be of a different nature, as they are completely absorbed. No explanation of this phenomenon is offered. It is merely stated as a fact.

In proportioning the conducting member, then, a happy medium has to be found so that it will carry the maximum legitimate load of pressure waves without absorption, and be able to absorb the maximum possible amount of resonance that may appear. This proportioning is an essential part of the design of successful instruments. A provisional mathematical relationship has been found and used with success, but its accuracy has not been sufficiently proved, as yet, to warrant its publication. It is hoped that the writers will be forgiven if the explanation of the function of the cellulose acetate reinforcement is not as lucid as it might be. The reason for this is that this body acts as an absorber and a modulator; at the same time, it performs a function which is neither of these things and for which no word exists, and the exact operation of which is still imperfectly investigated. For the moment it suffices that enough is known about the application of this property to enable it to be utilised.

The members are sometimes slightly recessed in the centre of the area where they bear on the crystal. This is to ensure a perfectly even bearing on the four corners of the crystal, which are the sensitive regions. The crystal liberates its charges between the centre girdle and the centres of the two basal planes, so that if the bars are recessed in the middle, steps have to be taken to ensure adequate contact with the tinfoil in that region.

In the gramophone apparatus or sound-box, the pressure-waves are led in from one end only, but in the case of microphones for sound transmission, the pressure-waves may be led into the crystal from one, or both ends simultaneously, from the receiving surface. In the sound-box, constant pressure is applied by the spring

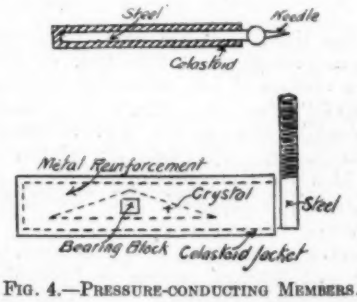


Fig. 4.—Pressure-conducting Members.

duralumin flange; in the microphones, by spring washers, or leaf springs (fig. 2), on the cradle. To carry asymmetry a stage further when two conducting bars are used, it is the practice of the writers to make these of different lengths, while in one the metal reinforcement is outside the "celastoid," and in the other inside. The total volume of the two arms does not exceed the factor of the crystal constant. For ultra-sensitive instruments, such as hydrophones, where tone-quality is of secondary importance, the bars are made of glass-hard steel with "celastoid" encased in tinfoil as gripping pads. The surface of the metal is also

roughened. It should be noted that the size and volume of the receiving surface need bear no relation to the crystal used. It is only the proportioning of the conducting members by which the crystal receives the waves from the receiving surface that is of such vital importance.

The following is a description of some of the applications of piezo-electric instruments working on the principles described above:—

The chief use of the sound-box is for the radio-broadcasting of gramophone records. The tone is excellent, and permits of any amplification without distortion—three amplifying valves are usually sufficient—while the "needle-scratch" is removed by the simple method of shunting a small condenser across the crystal. This effectively absorbs the comparatively high-frequency alternations generated by the friction of the record. The results have been extremely satisfactory in every way, and have shown a very great improvement over any other method.

The sound-boxes have also been found of great service in testing amplifiers and other wireless instruments, as the output of the sound-box is completely undistorted and serves as a convenient standard of calibration. Sound-boxes are used in addition as "silent gramophones," that is to say, the sound-box with a suitable condenser shunt is connected to one or more head 'phones in series. The music can only be heard in the head 'phones, as the sound-box makes negligible noise in itself. This is useful in flats, hospitals, &c. Used with an amplifier and a good loud-speaker, it makes an ultra-loud gramophone with an excellent tone.

All piezo-electric instruments are very easy to amplify, as, being of the order of a megohm resistance, they may be connected directly across the grid and negative of the amplifier.

The transmitters, which are used with a special compound non-resonant receiving surface, produce clear and natural speech, which is entirely free from the distortion and resonance of granular microphones.

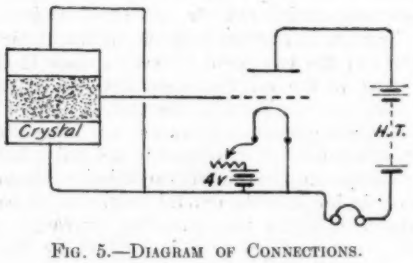


FIG. 5.—DIAGRAM OF CONNECTIONS.

At the same time, they are free from the metallic sound of magnetophones. This lack of distortion is due to the absence of any *movement* and the peculiar properties of "celastoid." The transmitters are absolutely "dead," and do not give preference to any range of frequency. They take the faintest whisper or a severe blow on the receiving surface with equal readiness, and are applicable wherever clear music or speech transmission is required.

Piezo-electric microphones of special construction have been used with marked success in hydrophone work, applying the above principles. In March last year the writers carried out one experiment at sea, which amply demonstrated that piezo-electric hydrophones, operating on this system, are infinitely more sensitive than any other type. Tested against the latest pattern magnetophone, with similar amplification, the "piezophone" was found to be much more sensitive and to be quite free from water-noise. This means that additional amplification will provide any required degree of sensitivity, as there are no extraneous noises to interfere.

An interesting point is that the effective range of these piezophones is directly proportional to the amplification applied. That is to say, the range extends along a flat curve with a sharply-defined step for each extra valve that is used. For example, if a sound can be heard at 500 yards with no valves, with one R valve that sound can be heard clearly for 2,500 yards, but *no further*. Between 500 and 2,500, there is no falling-off in distinctness, but at 2,500 it disappears completely. If another valve, corresponding to five stages of amplification, is used, the range will be extended to 12,500 yards, and so on.

Other work has prevented the writers from carrying out any further tests, but an instrument has been designed which, it is hoped, will be absolutely directional in operation. This is very hard to achieve, as pressure waves under water are a very different proposition to waves in air. At the same time, if it can be accomplished, it will be of great utility, since a robust directional hydrophone which does not possess the many disadvantages of existing types is urgently required for commercial navigation as well as in time of war. Piezo-electricity has an undoubted future in this field.

Among the curious properties of Rochelle salt crystals may be mentioned the peculiar fact that a permanent negative charge of about 1/20th volt is always to be found across the two ends and the centre girdle. This has never been explained, as there is no chance of chemical action. Another phenomenon for which no explanation is forthcoming was the complete molecular disintegration of half a crystal when subjected to a curious combination of sounds. This occurred under circumstances which can never be exactly repeated, so it is not probable that the phenomenon will occur again. Another crystal, which was in parallel with the exploded one, sustained no damage of any kind, and all possibility of electrical interference has been discounted. The temperature generated reached at least 232° C., and there was a sufficient quantity of heat to partially destroy the thick celastoid and to completely fuse that half of the crystal which was not reduced to carbon and gas. There was also abundant evidence to show that the disintegration started internally from the centre of the crystal. The full and exact circumstances and the relics have been laid before several eminent scientists at Cambridge, but none of them have been able to offer any explanation, while several have gone so far as to say that this is something totally new of great interest. It is amusing to note the verdict of one of the most eminent: "There is nothing in this which cannot be simply explained in the light of our present knowledge. There is nothing new left to discover. . . . Oh, no, *I* cannot explain it, but then, you see, I am much too busy to bother with anything so trivial."

Another interesting point is the ultra-sensitivity displayed by the crystal when it is just on the point of mechanical overstrain. Constant pressure is gradually applied to the crystal till there is a gentle cracking sound in the head 'phones. This is the moment of overstrain, and the crystal displays a peak sensitivity. If more pressure is applied, the structure becomes overstrained, the crystal becomes very insensitive, and must be rejected. If the pressure is slightly relaxed, the sensitivity decreases over a period of some hours till a constant is reached. In the course of a week or two, however, the crystal will "mature" and improve in sensitivity. These changes are very gradual and very slight, and after about three months the crystal reaches a perfectly constant condition. Once a crystal has been assembled into an instrument, it should not be taken out and used in another, as the second assembly destroys most of its sensitivity. It can, of course, be melted down and re-grown.

From first to last, a crystal takes about a week before it can be used, but a longer seasoning period is always an advantage. The most important part of the crystal process is the production of a seed crystal of the right shape and size from which to grow the finished crystal. Crystals may be grown to any size quite easily, though a length of about five inches is found to be the limit of commercial possibility. No special advantage results from the use of large crystals for most purposes. Cry-

stals 1⅜ in. long are used in sound-boxes. After being grown, crystals are thoroughly dried and baked to expel all moisture. They are not hygroscopic, but a protective coat of varnish applied when they have been assembled is never amiss. The centre tinfoil girdle is affixed with a special wax compound.

The above is not intended to be a complete description of the possible uses of piezo-electricity. Many other applications will suggest themselves to readers, and the writers are at present engaged on several quite novel applications. These are not sufficiently advanced to be described at present. Piezo-electricity is still in its infancy, and in a few years' time the present devices may seem crude and absurd.

It may be of interest to remark that all the above work has been carried out in spare time at very irregular intervals and with an almost complete absence of scientific facilities. No measuring instruments of any description have been available, which accounts for the absence of data as to the potentials generated, and forestalls other questions, which will instantly be asked by scientists.

Experiments have been carried out entirely by the light of nature from the evolution of the commercial process to the use of the special materials and construction. There was also a complete absence of any knowledge of the laws of sound, which was, as a matter of fact, an advantage, as piezo-electric microphones do not obey these laws, and any preconceived notions on this subject might have seriously hampered the acceptance of those theories without which it is impossible to use piezo-electricity outside the laboratory. The writers are fully conscious of the many defects of this article, but the above explanation may account for some of them.

SOME NOTES ON CHANGING OVER A NETWORK FROM D.C. TO A.C.

By M. FARRER, M.I.E.E.

(*Concluded from page* 247.)

One or two jobs, where we were up against a number of small motors all requiring speed variation, were dealt with by installing motor generators and so continuing to give the consumer direct current for his motors.

More trouble was experienced with special appliances, such as sausage machines, dental lathes, &c., where the motor was built into and formed part of the machine. In such cases it was usually found more convenient to buy a complete new machine, getting the makers, if possible, to take the old machine in part payment.

In Twickenham we adopted the Century single-phase motor as standard. This is a repulsion induction motor, starting as a repulsion motor with series characteristic and running as an induction motor with short-circuited rotor and shunt characteristic.

Such motors are more expensive than squirrel-cage or slip-ring motors, but offer many advantages in the case of a change-over scheme. The small sizes can be started by means of the already existing d.p. switch and nothing else; larger sizes require the addition of a simple graduated resistance starter. The starting torque is high, and it is not necessary to go to the trouble of installing fast and loose pulleys, clutches, or other similar devices. The starting current is no greater than that of a d.c. motor.

In all cases, we simply removed the d.c. motor, fixed the Century motor in its place with a starting resistance, if over 3 h.p., and connected up to the existing main switch.

No circuit breakers have been installed, but it must be mentioned that the motors dealt with in this area were only small ones, not exceeding 15 h.p. in any case.

The average cost of changing the motors was £16 10s. per h.p. This figure is arrived at after allowing for the d.c. motors removed, a value about 20 per cent. below their market value as second-hand motors. The figure also includes all labour costs for removing the old and fixing the new motors. The cost is higher than might be anticipated, and this is due to the large proportion of very small motors, *viz.*, ½ h.p. and 1 h.p., in this area.

Plant, meters, and motors having been ordered, any necessary alterations which will be required to the mains network can be put in hand.

The services of a wireman will also be required for some considerable time to run for each consumer a loop from the main cut-outs to the meter, to feed the potential circuit of the a.c. meter.

As the preliminary work approaches completion, a schedule should be drawn up, dividing the area into sections in the order in which they will be changed over. Each section will contain as many consumers as can be conveniently changed over in a day.

The sections must be arranged with due regard to the necessity for maintaining as good a supply as possible, in the intermediate stages, to the sections temporarily remaining d.c. This will require careful consideration and, in some cases, a certain amount of scheming.

When it is possible to fix a definite date for a start on the first section, it is advisable to send out a further circular letter to consumers, reminding them of what is about to take place, stating the date their meters, motors, &c., will be changed, and finishing up with a polite request that they will facilitate the work as far as lies in their power.

As far as the actual change-over is concerned, the following procedure was adopted and worked satisfactorily:—

The meters required were delivered to the electricity works and given a rough test in batches, and then stored in a lock-up garage, temporarily hired for the purpose and situated near the centre of the change-over area.

As early as possible on the date fixed the distributors about to be changed over were made dead and, where necessary, jointers' gangs were started to carry out any necessary alterations to enable the cables to be thrown over to the a.c. system. Most of this work, however, had been carried out previously.

A meter reader and a slot-meter collector went from house to house reading the meters (and collecting cash in the case of the slot meters). The readings were noted in the meter-readers' books and also entered, together with the name and address of the consumer, on a red printed label which was tied to the meter.

A gang of meter removers followed these men, removed every meter, joined up the meter leads so that supply was maintained, and deposited the meters on the pavement, where they were picked up by a light van.

As each road was cleared of meters, the van returned the meters to the stores. Here the labels were checked, and equivalent numbers of each type and size of single-

phase meter were put aside and blue labels fastened to them with the name and address of the consumer, size of meter, &c., as taken from the red card. On this card was also entered the serial number of the meter and size, &c.

When all possible meters had been removed, generally by mid-day, the distributors were made alive with a.c., and in the interval the meter fixers went round again to any houses where admission had not been obtained previously. If still unable to obtain admission, they left a printed notice advising the consumer of the fact and requesting him to write to the company to make an appointment as soon as possible.

The van now commenced delivering the new meters along the road, and the meter fixers fixed them, making a rough test to see (1) that the meter started on one lamp, (2) that the meter did not run on the shunt.

They also entered the reading of the meter on the red card with a note if any defects were observed. These red cards were subsequently returned to the stores, and the details on them entered up.

From 60 to 100 consumers were changed over each day, and it was found necessary to employ from six to nine men to complete the work within reasonable hours.

No attempt was made to cut off consumers into whose premises admission had not been obtained, and they, therefore, continued for the time being taking an a.c. supply through their d.c. meters.

The total number of consumers so far dealt with has been 1,244, and the total number of meters 1,322, of which 551 were slot meters.

The total cost of changing the meters, *i.e.*, delivering and fixing the new meters and removing and carting away old meters, storage, &c., was £396, or 6s. per meter. The capital cost, *i.e.*, cost of new meters, less original value of meters removed, was £968, or about 14s. 7d. per meter. The majority of the old meters have been sold at prices higher than cost.

The total cost of the whole job was £5,492, allocated as follows: Capital, £3,307; revenue, £2,185.

Land, buildings, plant, additional cable work, and net cost of meters were charged to capital.

Alterations to existing cables, cost of supplying and changing motors, fixing shunt wires, and fixing and removing meters, were charged to revenue.

It will be seen that the capital cost works out at £2 13s. 2d. per consumer, and the revenue cost to £1 15s. 1d. per consumer.

The change-over was carried out in 18 working days.

The district has now been working on single phase for 18 months, and the result of the change has been completely satisfactory. The cost has been no more than would have had to be incurred for additional d.c. plant or feeders to meet the growing demand on the system. A better and more uniform pressure is maintained throughout the area. The single-phase motors have given no trouble whatever.

Best of all, cable faults have practically ceased. Three or four cases of break of continuity have occurred, but these were expected, as it was known that many of the positive cables were badly sulphated in places. Up to date, however, not one short circuit has occurred, although, prior to the change-over, such short circuits averaged 50 per annum.

If one takes £8 as the average cost of locating and repairing a fault—a moderate figure—and also assumes that the faults drop from 50 to 8 per annum, then the annual saving in repairs to mains will be £336 per annum, or 6 per cent. on the total cost of the change-over. A further saving results from the increased efficiency of the a.c. distribution.

The total units sold in the area dealt with are approximately 300,000 per annum.

If we take the efficiency of the a.c. distribution as 95 per cent. and the efficiency of the d.c. distribution as 85 per cent., the saving in units generated is 37,000 per annum, which at, say, 1s. per unit = £154—nearly another 3 per cent. on the total expenditure.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Earthing C.T.S. Cable.

In reply to your correspondent, Mr. J. Dean, of Aberystwyth, the proper way of earthing C.T.S. sheathing is to vulcanise a piece of rubber tubing to the sheathing and run it to a rubber hose pipe, and vulcanise it on to that. Rubber hot-water bottles and pieces of rubber or ink eraser in the vicinity should be carefully insulated.

Leonard F. S. Sington.

Liverpool, *February 20th*, 1923.

Bed-switch Dangers.

In switching off the light from the bed the other night I noticed that its extinction was not instantaneous. Investigation showed a streak of brass upon the small, movable piece of porcelain, and it was easily possible to dim the light to any extent, with consequent heating of the switch.

These silent switches are no doubt convenient to those experienced husbands who find that it is best to let sleeping wives lie, but is there no switch with a quick make and break, but without the resounding snap that is so painfully evident in some of the best makes?

F. R. Cripps.

Worthing, *February 19th*, 1923.

Watt-hour Meters for Alternating-current Consumers.

In your issue of February 2nd Mr. A. Hugh Seabrook asks the question: "Can anyone tell me the name of the genius who invented watt-hour meters for consumers on alternating-current systems, and give me the reasons why we should not revert to ampere-hour meters and make the consumer pay for the unit as defined in Orders and Acts, instead of supplying him with something a great deal more than the official unit, and at the same time spending huge sums of money in making the amperes he uses coincide with the amperes he pays for?"

The question, no doubt, is a pertinent one at the present time. Although the circumstances mainly instrumental in bringing about the existing conditions may not be obvious to those not actually engaged in meter work, the answer is not a difficult one, and a brief consideration of the respective methods of charging for d.c. and a.c. electricity supply may be of interest.

For d.c. systems ampere-hour meters of very considerable accuracy and reliability can be produced at a comparatively low cost. On the other hand, d.c. watt-hour meters are costly, have a large shunt (or continuous) watt loss, and, generally speaking, although they are capable of giving fairly accurate results if of recent calibration, this accuracy rapidly falls off in service, and therefore the periods of recalibration must be short and frequent and the maintenance costs proportionately high, otherwise there is a corresponding considerable loss of revenue. The reason for the preference for ampere-hour meters on d.c. systems is therefore self-evident.

For a.c. systems the conditions are reversed, and a brief reference to the history of the "Induction Meter" gives a rational answer to the above question. Not to quibble as to the exact order of precedence—for several investigators were independently working on similar lines—one of the very first a.c. meters was the well-known ampere-hour meter of Mr. O. B. Shallenberger, manufactured by the Westinghouse Co., at Pittsburg, Pa., U.S.A., and known by his name. This meter had a fairly long and successful run, and deservedly so, because it placed the charging for electricity supply on a reasonable and rational basis, and was, therefore, a great advance in central-station engineering practice, as all will agree who have any recollection of the old flat-rate systems. It put electric light within the reach of small consumers and made electricity supply a profitable undertaking.

When, however, we come to the question of accuracy, it becomes a matter of relativity. Compared with the flat-rate system, the ampere-hour meter was *extremely* accurate; but relative to the modern watt-hour meter, it was extremely the opposite. Those who had experience in the testing of old ampere-hour meters will confirm that they not only functioned as coulomb-meters, but were fairly reliable frequency meters, as well as barometers. It is questionable, however, whether the modern electric supply engineer would regard these latter features as desirable. It is well here to recall that the period referred to is that of the early days of the carbon-filament lamp, when installations at voltages as low as 50 volts were common. At that time it was considered quite satisfactory if a 5-ampere meter would start and continue to run on an 8- or 16-c.p. lamp and came (nearly) within 2½ per cent. accuracy from full to one-third load.

To-day is the period of high-voltage metal-filament and half-watt lamps. The genius who invented the first a.c. watt-hour meter was this same O. B. Shallenberger, and it is to be assumed that he considered it an advance on his first meter. The writer of this letter, then in youthful meter days, well remembers the first sample Shallenberger watt-hour meter submitted to him for test and report; his immediate prejudice against its bulk, weight, and small cyclometer dial, and his precipitate conversion on making a test, and the astonishment with which he regarded a meter that would register the current consumed by his Weston voltmeter!

Let us not forget to recognise merit where it is due. These early workers were exploring untrodden ground. It is a thousand times easier to make a considerable improvement on an existing model than it is to make the first model. Only those who have had the opportunity of following up the steps in the development of the Shallenberger watt-hour meter can know the care and thoroughness with which he thrashed out all the problems involved, and established the type and model which all others since have followed. This meter embodied every essential feature of the induction watt-hour meter as we now know it, and it only lacked the conveniences and refinements. If his first meter put the charging for electricity supply on a rational basis, his second placed it on a scientific basis.

As regards "The official definition of a unit of electricity for electricity supply purposes," Mr. Seabrook's implied interpretation is probably as doubtful as the Board of Trade approval of any known a.c. ampere-hour meter. The official unit is "a current of 1,000 amperes at a pressure of 1 volt for a period of one hour." Without pressure there could be no current. Without current nothing could be accomplished (electrically). When the load is not reactive there is no ambiguity—at constant pressure, ampere-hour meter and watt-hour meter (theoretically) give identical results. If the load is reactive it will be necessary to supply more than one volt to give the consumer his 1,000 amperes. This is because the 1,000 amperes set up a "reactive" voltage and it is necessary to *balance* this reactive voltage in order that the consumer may obtain his 1,000 amperes at *one* volt pressure. The excess or balancing voltage produces *no* current and, therefore, does *not* enter into the official definition of the unit. Thus the wattmeter registers correctly official units; the ampere-hour meter does *not*, and the charge based on its reading would be too high and illegitimate.

The usual way, when referring to reactive circuits, of speaking of "idle" or "wattless currents" is inexact and misleading, although convenient. There can be no "idle" or "wattless" currents, for if there were there would not be so much thought and ingenuity expended in getting rid of them. The really scientific way of regarding the matter is not as a current out of phase with the voltage, but as a voltage producing current, and therefore producing energy, plus another voltage out of phase with the current not producing energy. Thus it is necessary to take a current of increased intensity to obtain a given power, owing to the reduction of the available supply voltage.

It must not be taken that the writer is attempting to defend a uniform kWh basis of charging, but every question has more than one aspect, and the kWh basis was entirely satisfactory until it came to the supply of power in bulk at low power factors; then the problem became acute. In such cases it is reasonable to penalise consumers for low power factors, and the kVAh method provides a comparatively simple method of doing so if reliable and accurate metering apparatus on this basis is obtainable. It does not, however, follow that the small lighting consumer should also be so penalised, because his rate of charging is surely already high enough. It is because the normal charge for power is made very low that it becomes necessary to penalise the consumer when he takes his power in a manner not economical to the supplier.

But suppose, for example, a lighting consumer whose system was metered by an ampere-hour meter desired to run a small fan occasionally, which in the nature of things has a fairly low power factor. Would it be right or just that he should be charged for this small power about three times what he is charged for his light? One could hardly argue that such loads are a tax on the resources of the supply, especially when the load is otherwise mainly at unity power factor. Whatever may be the most suitable method of charging for the supply of power in bulk, the watt-hour meter provides the fairest and simplest method for the small consumer, and the small consumer is just as much entitled to consideration as the large, because electricity supply is, *primarily*, a public convenience. On the other hand the large consumer is often a nuisance to the lighting supply, and that is one reason why he should be penalised when he is so.

Again, the watt-hour meter gives by far the most economical method of charging for electricity supply for lighting purposes. It does not, even yet, seem to be realised that the loss of a watt or so in the shunt circuit of a meter is as nothing if reliability at light loads is thereby gained. The cost of the former is only at the rate it costs to generate, but light-load losses are a loss of revenue at 6d. or 7d. per unit. One of the greatest sources of loss to a central supply, if not the greatest, is due to the lamp left burning in the cellar, hall, or servants' room, which does not, or barely does, register its consumption on the meter.

Finally, to refer to one more matter which does not in general appear to be given the attention which its importance merits: if central supply engineers kept a record of the ratio between the mean load and installed meter capacity, and made every effort to increase this ratio—in other words, to keep the installed meter capacity as low as possible—they would find their efforts bear fruit. A meter—that is to say, a good meter—will stand considerable overloads, and the capacity of the meter installed should generally be determined by the usual load it is to register, not by the possible maximum.

G. North.

Manchester, *February 17th*, 1923.

A Motor-starting Problem.

Respecting Mr. Smith's letter on the above in this week's Review, it appears that the ordinary single-pole motor starter is in use in each case where the motor is started by reason of an earth on the starter. Of course, it is obvious that this will happen on a three-wire system, as immediately the main switch is closed the motor will have 230 volts across its terminals with the starter handle in the "off" position.

My suggestion is that in the case of circular saws and other machines rendered dangerous by such faults, double-pole controllers of the tramway type should be used.

This would, I think, remove the danger of motors starting before the controller was moved and at the same time, of course, a fuse would be blown, revealing the fault.

A. H. Short.

Newcastle-on-Tyne, *February 14th*, 1923.

Arc Welding.

In answer to Mr. Langdon-Davies's letter in your issue of the 9th inst., I am pleased to state my opinion.

I find that the a.c. arc is not as useful as the d.c. arc, due to the fact that one cannot use a carbon electrode with a.c. During metal electrode welding a carbon electrode has a great many uses.

Personally I think that the bare wire flux-coated electrodes (example, those supplied by the Premier Welding Co.) have more uses than asbestos-covered ones.

E. Gilbert.

Barrow, *February 19th*, 1923.

High-voltage Power Transformers.

British transformer manufacturers will appreciate Mr. W. T. Taylor's letter of the 9th inst., as expressing his opinion that there is no need for engineers and others to go outside this country with their orders for 110-kV, and even 132-kV, high-pressure apparatus.

There is, however, one point which I cannot pass unnoticed, and that is regarding the type of transformers. Mr. Taylor states that the upright core type is the more common type for this class of work. This is not a safe generalisation, as our experience and that of several large Continental and American manufacturers has shown that, for other than small e.h.p. units, the shell-type of transformer is the most satisfactory.

We have, in fact, standardised on this type for other than relatively small e.h.p. units. For example, the 2,500-kVA, single-phase, 132-kV transformer mentioned in my letter of the 17th ult. is of the shell type, while the 1,000-kVA, 88-kV, 3-phase transformer mentioned in the same letter is of the core type.

There is a certain fairly well-defined line of demarcation where it is desirable to change over from one type to the other, but a technical discussion of this would take up too much of your space.

A. G. Ellis,
Chief Engineer (Transformer Dept.)
Metropolitan-Vickers Electrical Co., Ltd.

Manchester, *February 19th*, 1923.

Dynamic Braking Contactor Gear.

With reference to the illustration in your issue of February 16th of a dynamic braking equipment as applied to a 100-ton double-crab locomotive overhead crane, I am sure, from a cranebuilder's point of view, that the application is a special feature of electric braking superseding the inefficient and unreliable Weston type of mechanical disk lowering brake.

Those who are familiar with Admiralty and numerous consulting engineers' specifications know how the old-fashioned Weston type of mechanical brake is still included for all types of crane on direct-current systems, whereas enterprising steelworks, shipyards and railway companies, both at home and abroad, have discarded the mechanical brake in favour of dynamic braking on such systems.

Dynamic braking provides a means of lowering all loads under perfect control and without any fear of exceeding a safe maximum lowering speed.

Within my own experience dynamic braking has been fitted on all sizes of cranes from 1 ton to 100 tons, and in conjunction with motors up to 125 b.h.p. on voltages from 200 to 550 volts d.c., and it is (in my opinion) second only to the Ward-Leonard system.

Referring to the equipment illustrated, I should be pleased to hear:—

(1) If any special arrangements were made to ensure that the load was divided equally between the two motors, or can either motor be loaded and the other run light?

(2) Can any figures be given as to the speeds and current taken on each notch with, say, 100 per cent., 50 per cent., 25 per cent., and light hook?

(3) Are both hoist motions controlled by one master controller, or by two separate master controllers?

Electrical Crane Engineer.

February 19th, 1923.

The Placing of Contracts by Public Bodies.

The letter appearing in your issue of February 16th, from Mr. C. W. Crosbie, is one of those brilliant examples which occur from time to time of arguments written round entirely misleading and erroneous premises, and it is in the interests of all those who have the industrial welfare of this country at heart that the statements contained in the letter should definitely and conclusively be refuted. Mr. Crosbie is unfortunate in the selection of his so-called example, as on the same bases of interest, depreciation, &c., the true facts of the case are very different. In the first place, it would be very interesting to know from what source your correspondent obtains his information that the permissible tolerance on guaranteed efficiency of British transformers is 1½ per cent., for to the writer's definite knowledge the leading transformer manufacturers of this country would not ask for a tolerance greater than 0.2 per cent. on a transformer having a total loss of 2 per cent. In general terms, the tolerance on both iron and copper loss is 10 per cent. of each of their respective values. It is apparent from the figures quoted that the tolerance has been taken into account in arriving at the annual charges for the losses, and this implies that the transformer manufacturer feels quite satisfied so long as his transformer performances just reach the limit of the tolerance. This is distinctly not so; in the majority of cases actual test results are inside the guarantee figures.

While the output only of the transformer taken as an example is mentioned, it is reasonable to assume that one for standard distribution pressure and frequency has been chosen, and, therefore, the figure of £260 for the British apparatus is too high. For a 200-kVA, 6,600/440-volt, 50-cycle, 3-phase transformer complete with oil, rated in accordance with the B.E.S.A. rules, the present-day price is approximately £200, and the following table is submitted, based on the above figures:—

	British.	Foreign.
Guaranteed efficiency	98%	98%
Permissible tolerance	0.2%	0.2%
Capital cost	£200	£160
Annual charges:—		
Interest and depreciation at 7½%	£15	£12
Sinking fund, 15 years at 5% ...	£9 5 0	£7 8 0
Iron loss, cost of energy, at ½d. and 100% L.F.	£18 5 0	£18 5 0
Copper loss, cost of energy, at 1d. and 20% L.F.	£4 8 0	£4 8 0
	£46 18 0	£42 1 0
Capitalised, 15 years at 5%	£507	£454
Present value	£707	£614
Difference in present value ...	–	£93
	£707	£707

It will be seen from this table that the difference in present values is £93 as against Mr. Crosbie's figure of £1,002, and obviously the whole of his arguments fall to the ground. In view of the relatively small difference which is now shown to be nearer the true facts of the case, it is admissible further to justify selection of the British apparatus. In spite of having at one time been engaged with one of the leading electrical engineering companies in this country, Mr. Crosbie is apparently not aware that the British transformer is second to none, and that the qualities of both design and workmanship are such as to leave no question concerning their superiority over foreign manufacture. This can always be verified by the customer during all stages of manufacture and during actual works tests, as it is always permissible for the customer to carry out inspections whenever he desires to do so. This is generally not likely to be done when buying foreign transformers. The manufacturers' engineers are always available almost immediately for the purpose of personal discussions on any points which may arise in connection with the apparatus supplied, or even for consultation in connection with extensions to existing schemes, and again this facility is not readily available in the case of foreign manufacturers.

Mr. Crosbie's economic reasoning is no less fallacious than his technical example. The price of a transformer is made up of the cost of materials, cost of labour, overhead charges, and profits. When the wages, charges, and profits are paid in this country they enter into circulation as wealth wherewith further purchases may be made from British industry. If the materials are purchased in this country, the same cycle of events takes place with regard to them. If, on the other hand, the wages, charges, and profit are spent in another country, this country is obviously the poorer for their loss.

Electrical and other engineering plant is one of Britain's main lines of manufacture. Perhaps Mr. Crosbie's idea is that this should be sacrificed to the efficiency of the rest. Presumably British engineers and mechanics will then turn their attention to weaving or biscuit-making. Or his theory may be that a firm, say, of British motor manufacturers, to render itself more efficient to compete in the export trade, should not only surrender its home business but equip its own works with foreign-made motors. The increased efficiency and low capital cost of the foreign motors will no doubt compensate for such trifling considerations as reduced output and the presentation to the foreigner of a unique advertisement.

"Restrictions on the freedom of sale and barter" are hardly grievances which can reasonably be complained of by countries which erect tariff walls against our goods, yet find in this country a free market for their own.

With regard to the exchange, does anyone imagine that if all the engineering works in Britain were to shut down in favour of our German competitors, the débâcle of the mark would be more than slightly arrested, while the printing presses continue to work overtime upon it?

S. Austen Stigant,
Manager, Transformer Department,
Johnson & Phillips, Ltd.

Charlton, *February 20th, 1923.*

The Theft of Electricity.

Having just returned from a business trip on the North American Continent, I have read with interest Mr. Preston's letter in your issue of January 19th urging the use of a double-pole fuse and meter in one case, and Mr. Willingham's article in your issue of February 16th.

On my visit I was very much struck by the extensive use in the United States and Canada of such a system as Mr. Preston proposes. The so-called "Meterserv" system, which as far as I could see, seems to be almost universal there, consists of a sealed protecting metal cabinet totally enclosing a double-pole switch and fuses. One end wall of this cabinet consists of a stamping made to fit the terminal chamber of any one of the various meters on the market there. The correct type of stamping which may be required is snapped into place, so that the terminal chamber of the meter projects well into the switch-fuse cabinet, giving complete encasement; or, if the meter terminal chamber is of such a nature that it cannot be itself inserted into the cabinet, standardised adapters are employed. The cabinet is locked or sealed and fitted with a lock-off device, which, when set by the supply authority, prevents the switch from being closed. The system of standardised end plates and adapters of various types seems to get over the difficulty Mr. Willingham mentions of not being able to substitute a different type of meter to that installed should the supply authority wish to do so at any time. A small stock of these end plates or adapters, which cost very little, is usually, I believe, carried by the supply authority and snapped into place by the meter attendant if it is desired to substitute a different type of meter at any time. Incidentally the enclosed cut-out is fitted with special terminals, which enable the meter to be tested at any time by the proper authority without interfering with the supply of current.

The present type of service outfit, consisting of meter, connecting cable, sealed main fuses, and also consumer's d.p. switch, is thus replaced at a lower cost by a single piece of apparatus, viz.: combined meter and fused switch with all terminals enclosed, completely safeguarding against personal contact and theft of current or tampering.

Future extensions are taken care of by a simple system of snap-in metal troughs and covers to connect up additional cabinets. The body of the trough fits into a U-shaped knock-out opening in the side wall of the cabinet, and is locked to the cabinet by flanges at each end. The trough cover is fixed and locked by the closed cover of the cabinet.

I would add that the usual practice is to employ armoured cables, and cabinets are made with concentric knock-outs of different diameters, so that the armoured cables can be threaded through and bonded to the cabinet, or by using a larger diameter knock-out, a bushing can be fitted in for other types of cables.

A. R. Porter,
Managing Director,
The Key Engineering Co., Ltd.

Manchester, *February 19th, 1923.*

BUSINESS NOTES.

Bankruptcy Proceedings.—H. J. W. Embury and K. S. Embury, trading as H. & K. Embury, electrical and mechanical engineers, 29 and 110, Queen Street, Newton Abbot.—The public examination of these two debtors took place at Exeter on February 15th before the Registrar. According to the *Western Morning News*, the liabilities to 94 unsecured creditors totalled £4,683. Debtors' stock-in-trade was valued at £1,400, and fixtures, &c., £100, and the deficiency was £1,194. Alleged causes of failure were trade depression, depreciation in value of stock, heavy capital outlay on electric light plant at Kingskerwell, and a loss of from £100 to £150 in providing water-power machinery there, which proved useless owing to the dry season; law costs, over £150 on writs, &c., during the previous six months; and illness of partner for three months.

In the course of his examination, K. S. Embury said that they filed their petition on December 18th in consequence of the levy of executions. His brother started the business in April, 1919, and he joined him in November with £50 capital, added to £160 of his brother's. In May, 1921, they started providing electric light for Kingskerswell. They erected the poles, wires, plant, &c., at a cost of from £2,500 to £2,800. A number of accounts rendered since the statement of affairs were omitted through being overlooked. A shop they had at Totnes was closed two years ago; it was a failure. In 1921 he believed they paid their way. In 1922 they lost heavily, not on the ordinary daily trading, but rather owing to depreciations. Lamps, of which they carried an enormous stock, dropped nearly one-half in price; there were three drops in one year. He estimated that in December, 1920, they had a surplus of £300. Their statement showed depreciation of stock £300, and alterations and improvements £210. He first realised that they were insolvent last December.

Mr. A. L. Honey, Exeter (trustee), said the committee of inspection had had debtors before them. The trouble had been inexperience in the business and trying to go ahead too rapidly. The committee was quite satisfied with the statement. The creditors' feeling was one of sympathy.

H. J. W. Embury said that they were hoping to negotiate a sale of the Kingskerswell undertaking for £2,000 or more in November last, but it never came to anything.

The examination was closed.

A. C. Stuart and C. Perrier (Stuart Wireless Telephone Co.), 109, Kingsway, W.C.—Receiving order made February 12th on creditor's petition. First meeting, February 26th. Public examination, April 24th, both at Carey Street, W.C.

H. Parr, electrician, 2, Strawberry Dale Square, and 1, Back James Street, Harrogate.—Receiving order made February 12th on debtor's own petition. First meeting March 5th. Public examination March 16th, both at the Court House, Harrogate.

A. Satterthwaite (Gregson & Co.), electrical engineer, 22, Dutton Street, Liverpool.—First meeting, February 27th, at the Official Receiver's offices, 11, Dale Street, Liverpool. Public examination, March 13th, at the Court House, Liverpool.

H. Truelove (H. Truelove & Co.), electrical engineer, 19, Shepley Street, Stalybridge.—Last day for proofs for dividend, March 3rd. Trustee, Mr. J. G. Grant, Official Receiver, Byrom Street, Manchester.

L. Seddon (Electrical Engineering Co.), electrical engineer, late of 276a, Buxton Road, Stockport.—First meeting, February 27th, at the Official Receiver's offices, Byrom Street, Manchester. Public examination, March 13th, at the Court House, Stockport.

R. S. Magson (R. S. Magson & Co.), electrical engineer, 10, Stoney Stanton Road, Coventry.—First dividend of 5s. payable at Official Receiver's office, 9-11, High Street, Coventry.

Oswald Greathead and Walter Greathead, trading as Greathead Bros., 50, Burnley Road, Brierfield, Lancashire, electrical engineers and contractors.—The public examination of these debtors was held on February 13th at Burnley. The statement of affairs showed gross liabilities of £226, of which £223 was expected to rank, and there was a deficiency of £143. Debtors attributed their failure to shortness of capital and losses by a fire and bad trade. It appeared that they commenced business in January, 1921, in partnership without capital. They had never made a profit in the business. They made an offer of a composition of 6s. 6d. in the £ to the creditors, the money to be advanced by friends, and the Official Receiver was of the opinion that this offer was advantageous from the creditors' point of view. The examination was adjourned.

H. E. Checkley, plumber and electrician, 20, West Street, Morecambe.—Receiving order made February 16th, on debtor's own petition.

J. Bakewell, electric light and power engineer, 43, Waterside Road, Barton-on-Humber.—Last day for proofs for dividend, March 3rd. Trustee, Mr. J. F. Wintringham, St. Mary's Chambers, Great Grimsby.

R. W. Russell, electrical engineer and contractor, late of 30, King Street, Bridlington.—Receiving order made February 17th, on debtor's own petition.

Company Liquidations.—Irish Hydro-Electric Syndicate, Ltd.—Winding up voluntarily. Liquidator, Mr. W. Pocock, 18, St. Swithin's Lane, E.C.4. Meeting of creditors, February 26th.

Electric Brass Wares, Ltd.—Particulars of claims to be sent to the liquidator, Mr. E. A. Killip, 21, Tempest Hey, Liverpool, by March 3rd.

P. S. Doherty (Engineers), Ltd.—A meeting of members is called for March 19th at 9 and 10, Pancras Lane, E.C., to hear an account of the winding-up from the liquidator, Mr. E. Woodroffe.

New High Pressure Gas Light, Chemical, and Electric Supply Co., Ltd.—A meeting of members is called for March 20th at the Victoria Hotel, Manchester, to hear an account of the winding-up from the liquidator, Mr. W. F. Small.

Electrical Industries, Ltd., 9-10, Pancras Lane, E.C.—Liquidator, Mr. H. E. Burgess, Senior Official Receiver, released February 12th. As previously stated, this announcement has nothing to do with our contemporary *Electrical Industries*.

West London Scientific Apparatus Co., Ltd.—Winding up voluntarily. Liquidator: Mr. F. E. Goddard, 80, Drakefell Road, New Cross, S.E. Meeting of creditors, February 27th, at Anderton's Hotel.

Harris Electro Metals, Ltd.—Particulars of claims to be sent to the liquidator, Mr. B. L. Peace, 27, Slaithwaite Road, Thornhill Lees, Dewsbury, by March 12th.

Anglo-Mexican Electric Co., Ltd.—A meeting of members is called for March 22nd, at 47, Parliament Street, S.W., to hear an account of the winding-up from the liquidator, Mr. R. R. Skelsey.

Private Arrangements.—John Alfred Groome, electrician, 17, Windsor Road, Willesden Green, London, N.W.—At the adjourned meeting of creditors it was stated that the debtor had been unable to find guarantees, as had previously been suggested. The statement of affairs showed liabilities of £650, with preferential claims of £118, against assets estimated to realise £353, and it had been suggested that the debtor should find guarantors for a sum sufficient to pay a composition of 10s. in the £. After discussing the position, it was decided that the debtor should continue the business subject to his executing a deed in favour of Mr. H. G. Cregan, of Messrs. Wrigley, Lord & Cregan, of 4, Copthall Buildings, E.C., to secure the payment of a composition of 10s. in the £ by four equal quarterly instalments, the first instalment to be payable on May 1st.

F. J. Yates, trading as F. J. Yates & Co., High Street, Leicester, electrician.—A meeting of creditors was held on February 14th, when a statement of affairs presented showed liabilities amounting to £5,516, of which £4,554 was due to unsecured creditors, while the bank was partly secured to the extent of £962. There were also fully-secured creditors for £3,030. The assets consisted of cash in hand, 18s. 4d., cash at bank, £134, sundry debtors, estimated at £717, stock estimated to produce £3,128, partly completed contracts put down at £400, fixtures, fittings, &c., estimated to realise £752, plant, tools, &c., £349, and a motor-car estimated at £70, making a total of £5,553, or a surplus of assets over liabilities of £37. The debtor's wife was a loan creditor for £148. It was stated that the debtor started business 17 years ago with a capital of £15. Reasonable gross profits were made, but the result of late years, after allowing for expenses, had been a small loss, with the exception of the year 1922, when a net loss was incurred of £1,468 on a turnover of £6,252. Creditors issued writs against him, and a deed of assignment was executed on January 30th. No offer was made, and it was eventually resolved that the estate should be wound up under the deed of assignment, and a committee of inspection was also appointed, consisting of Messrs. Burndept, Ltd., Mr. Cripwell (Corfield & Cripwell), Mr. Orledge, Mr. Wrathes, and the representative of the General Electric Co. The following are creditors:—

	£		£
Burndept, Ltd.	512	Edison Swan Electric Co., Ltd.	91
English Electric Co., Ltd. ...	112	General Electric Co., Ltd. ...	111
Gilbert, A. E., & Co.	77	Gent & Co., Ltd.	63
Tudor Accumulator Co. ...	118	Steeds & Miles	67
Bill & Berry	88	Downes & Davies	92
Metallic Seamless Tube Co. ...	65	Baxendale & Co., Ltd.	147
Ruston & Hornsby, Ltd. ...	70	W. T. Glover & Co., Ltd. ...	61
Bilson & Sharpe	194	E. S. Yates	130

Dissolutions of Partnership.—Broadcast Wireless Instruments Co., wireless instrument makers, 144, Warbreck Road, Blackpool.—Messrs. L. Pollard, J. F. Fish, J. H. Nutter, H. A. Blackwell, and W. L. Turner have dissolved partnership. Debts will be attended to by Messrs. Fish, Nutter, Blackwell, and Turner, who will continue the business.

McGregor & Johnson, electrical engineers, motor engineers, and mechanics, 149, Brighton Street, Wallasey.—Mr. W. D. McGregor and Mr. E. D. Johnson have dissolved partnership. Mr. McGregor will attend to debts.

Wainwright, Baxter & Co., motor haulage contractors and repairers and electrical engineers, Park Garage, East Park Street, Morley.—Mr. W. Baxter and H. C. Gray have dissolved partnership. Mr. Baxter will attend to debts and continue the business under the same style.

GOULD & JONES, electrical contractors, &c., 29, Carne Street, Pentre.—Messrs. Gould & Jones have dissolved partnership. Messrs. D. Emrys Jones & Co. will attend to assets and liabilities and continue the business as D. Emrys Jones & Co., electrical contractors, plumbers, &c., at the same address.

SECCOMBE & SQUIRE, electrical engineers, 202, Manningham Lane, Bradford.—Mr. R. F. M. Seccombe and Mr. M. Squire have dissolved partnership. Debts will be attended to by Mr. Squire.

Trade Announcements.—RADIO INSTRUMENTS, LTD., have appointed Mr. C. B. Gresham (late sales manager of the Heating Department of Messrs. H. W. Sullivan, Ltd.) as sales manager of their Radio Department.

MESSRS. DIENY & LUCAS have moved their offices to 72, Victoria Street, London, S.W.1.

THE IRRADIANT LAMP WORKS, LTD., received so many applications from Home and Overseas for its calendar, to which we recently referred, that it has had to order a fresh supply. These will be ready during the next few days, and the requests of all applicants will then be satisfied.

THE BERKSHIRE RUBBER CO., of Maidenhead, has removed its wholesale and retail electrical business from 75, King Street, to 51, Queen Street.

The death of Mr. Walter Farrow is recorded in this issue, but the business of FARROW & SONS, electrical engineers, of New Street, Chelmsford, will be carried on as hitherto with the same staff.

MESSRS. AMOR & EAST, electrical engineers, have opened new premises at 84, King Street, Maidenhead, for the maintenance and repair of automobile electrical apparatus.

MESSRS. KERSHAW'S have taken additional premises at 95a, St. James's Street, Manchester. Catalogues, &c., of interest in connection with electrical contracting and supplying are desired.

An arrangement has just been concluded between MESSRS. DRAKE & GORHAM, LTD., London, and the ELECTRIC FURNACE CONSTRUCTION CO., of Philadelphia, U.S.A., under which the former have the sole right to handle in Great Britain and Ireland all types of electric furnace and auxiliary apparatus which have been developed in the United States by the latter company. Messrs. Drake & Gorham, Ltd., will, therefore, be able to supply either designs and specifications or complete furnaces of the arc, resistance, and induction type for all industrial purposes, and in addition the "Electro" steam boiler constructed in accordance with the designs of Mr. F. T. Kaelin, chief engineer, of the Shawinigan Power Co. Boilers of this type having a total capacity of over 200,000 kW have already been installed, or are on order in the United States and Canada, in sizes up to 25,000 kW, equivalent to an evaporation of 75,000 lb. of water per hour in the largest size boiler. Messrs. Drake & Gorham, Ltd., have a representative in the United States who is investigating the whole electric furnace position in that country.

Catalogues and Lists.—MESSRS. JULIUS SAX & CO., LTD., 24a, High Street, New Oxford Street, W.C.2.—An illustrated and priced pamphlet giving particulars of wall plugs conforming to the British Standard Specification 73-1919.

AUTOMATIC AND ELECTRIC FURNACES, LTD., 173-175, Farringdon Road, E.C.1.—Copies of pamphlets in French, Danish, and Spanish, describing Wild-Barfield electric furnaces. These have already been printed in German, Japanese, and Norwegian.

CRYSELCO, LTD., Kempston Works, Bedford.—Illustrated price list of "Cryselco" vacuum and gasfilled lamps, also train lighting and carbon filament lamps.

MESSRS. WARD & GOLDSTONE, LTD., Frederick Road, Pendleton, Manchester.—A four-page leaflet illustrating and describing accumulator-charging apparatus, including boards, d.c. dynamos, rectifiers, small generating sets, rotary converters, instruments, &c.

MESSRS. J. W. CARPENTER, LTD., 188-190, Earl's Court Road, S.W.5.—February price list of electrical materials and accessories, as adaptors, cable, casing, fuse boards, switches, conduits, &c.

MESSRS. PHILLIPS & TURNER, 115, Edmund Street, Birmingham.—A series of illustrated leaflets dealing with "galleries," shades, switch-plates, counterweights, brackets, rings, and other electric lighting fittings.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—A very comprehensive catalogue of electric lighting fittings (over 200 pp.), containing illustrations and prices of bowl fittings, pendants, lanterns, standards, shades, brackets, bronzes, &c.

MESSRS. BOULTON & PAUL, LTD., 135-7, Queen Victoria Street, E.C.4.—An illustrated and priced folder describing a water elevator of a multicellular band type for operation by hand or power.

MESSRS. CHAS. H. CHAMPION & CO., LTD., Carlton House, Regent Street, S.W.1.—An illustrated brochure describing "Acetox" oxy-acetylene welding and cutting plant.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, near Manchester.—An illustrated catalogue of batteries for radio purposes. Fully priced.

THE HYDRAULIC ENGINEERING CO., LTD., Chester.—Copy of a report upon the results of boring with the Mangnall-Irving thrust borer at Friern Barnet. (See ELEC. REV., February 2nd, 1923, p. 185.)

MESSRS. FERRANTI, LTD., 180, Fleet Street, London, E.C.4.—Pamphlet Tc. 174, fully illustrated, giving instructions for the use of oil-immersed static transformers.

Messrs. A. REYROLLE & Co., LTD., of Hebburn-on-Tyne, have sent us a neat ash-tray and card representing their explosion-proof mining switchgear.

Book Notices.—"M. & C. Machine Mining," February 1923. Glasgow: Mavor & Coulson, Ltd.—Articles on "Round Coal and Stack"; "Laying off Machine Faces"; "The 'Universal' in India"; "The 'Samson' Disk Coal Cutter"; and other kindred subjects, appear in this issue.

"The Mining, Refining, and Application of Nickel," by F. B. Howard White. Pp. x+118; 21 figs. London: Sir Isaac Pitman & Sons. Price 3s. net.

"Electrical Engineering Laboratory Experiments," by C. W. Ricker and C. E. Tucker. Pp. xiv+310; figs. 138. London: McGraw Hill Publishing Co. Price 11s. 3d.

"The Use and Advantages of Electric Power in the Factory" is the title of an excellent lecture delivered by Dr. J. F. Crowley, which has been reprinted from the *Journal* of the Royal Society of Arts by the English Electric Co., Ltd. (Publication No. 399). Copies can be obtained on application to the company.

Electrical Production in Russia.—At a meeting of the Industrial Planning Authority, held on February 5th, the programme of production of the Glavelektro group was considered. Twenty-seven establishments are to be at work, their complement of hands being 12,500. The production, which showed an increase last year, is to be further increased this year to 20,000,000 roubles value of production, which compares with 14,900,000 r.v. last year. The proposed production will make about 48 per cent. of pre-war; that of 1921-22 was 26.7 per cent. The new programme provides for an output of 168 roubles value per month per hand. At one of the factories of the group (the Petrograd Elektromachine Trust) the output per head per month almost reached pre-war level. Gradually the working power is returning to the electrical industry. The combined capital of the group under consideration is 60 million gold roubles.

Swiss Electrical Trade Statistics.—In the Imports Section of the Tables given in our last issue (p. 269) the figures for "Dynamo Electric Machines and Electric Transformers" were put in their wrong order. The figures appearing against "United States" are really the totals for all countries, and should be at the top; those appearing as totals are the imports from Germany, and the figures for other countries should likewise drop one line in each case.

Trade with South America.—We have received a pamphlet giving information regarding the British and Latin-American Chamber of Commerce (Inc.), of which Sir E. Manville is hon. president and Sir James Kemnal president. The address of the Chamber is South America House, 39, Bedford Square, London, W.C., which is occupied entirely by the offices of the Chamber and the numerous exhibits of leading British manufacturers. The pamphlet contains particulars of the objects of the Chamber (the promotion and extension of business relations between the United Kingdom and Latin-America and the provision of information to members); and lists of members of the Chamber and of exhibitors at South America House. Manufacturers and merchants interested in South American trade should communicate with the secretary, Mr. G. Potter.

Safeguarding of Industries Act.—NEW EXEMPTIONS.—The Treasury announces, says the *Birmingham Post*, that by Order under Section 10 of the Finance Act, 1922, a number of articles given in a schedule as not entered under the Customs Acts before February 18th, 1923, are exempted from the duty imposed on the said articles by Part 1 of the Safeguarding of Industries Act, 1921. The schedule contains the following:—

Complete induction coils which are dutiable only by reason of containing tungsten contacts as parts, provided it is proved that the value of the complete coil does not exceed 20s.

Articles other than illuminating glassware or electric lamps which are dutiable only by reason of containing lamp-blown ware as a part, and are proved to be exclusively ornamental.

Electrical Guarantees under the Trade Facilities Act.—A Parliamentary statement issued on Monday shows that the amount included for the South-Eastern & Chatham construction and power undertaking is reduced by £1,000,000 to £5,500,000. Other items in the list are:—

London Electric Supply Corporation.—Extension of power station at Deptford	£650,000
Tata hydro-electric power scheme (India)	850,000
Oxford Electric Co.—Extension of plant and mains ...	25,000

Correction.—We regret to find that an error occurred in the advertisement of Messrs. W. T. Rawcliffe, Ltd., appearing on page xxiii of our issue of February 9th. The sentence "Bases and tops *cannot* be supplied separate" should have read "Bases and tops *can* be supplied separate."

The Two Irelands.—We have pleasure in placing before our readers the following extracts from a letter on the state of affairs in Ireland recently received by a firm connected with the electrical industry:—"We wonder when it will be impressed upon the minds of English manufacturers and factors that when they speak of the unsettled state of Ireland, they do not seem to know that there are and always have been what might be called two Irelands, *viz.*, Ulster and Southern Ireland. Belfast is a large port in Ulster, in fact, one of the chief ports in the three Kingdoms, with nightly sailings from and to Fleetwood, Liverpool, Heysham, Ayr, Glasgow, and Ardrossan; in addition, it has bi-weekly sailings between Bristol and Belfast, and at least one railway in the week from and to London and Belfast by the Clyde Shipping Co. There is no unsettled state in what is now known as Northern Ireland, neither train wreckings, raidings or burnings as is going on in Southern Ireland under the Free State Government. The King's Writ runs in Ulster or Northern Ireland as freely as in England, and law, order, and authority are quite as much respected by the community as a whole."

Electrification of Northern Bohemia.—The administration of the Joint Stock Co., known as "Electrical Works of Northern Bohemia," has decided to increase its capital from 6 to 10 million crowns, and to conclude an amalgamation agreement with the Siemens Electrical Works, subject to State approval.

New Telegraphic Works in Sofia.—In regard to the new firm formed to manufacture telegraphic apparatus in Sofia, with a working capital of five million of levas, one-half of the funds will be supplied by the Bulgarian Government and the other half by the "Telegraphia" Czecho-Slovak Society.

Philadelphia Rolling Stock Equipments.—The electrical equipments for the 520 new cars for the Philadelphia Rapid Transit Co. will consist of two motors, control equipment, and an air compressor for each car. The contract, valued $1,500,000, is in the hands of the General Electric Co. (U.S.A.).

Labelling Objects in Show Windows.—When a shop window has been "dressed" with electrical devices for the public to see, the work is not complete unless steps are taken to let the public know what it is looking at. Anyone who has studied electrical window displays will agree that many of the items shown are incomprehensible to those unversed in electrical ways, without explanation or demonstration, and it is not practicable to keep electric fires on circuit for this purpose. Pointing out these facts, which should be obvious but are often ignored, Messrs. Electric Fires, Ltd., of Norwich, send us a specimen of a special label that they have devised to meet the need, together with a special clip by which it can be attached to their "Heatrae" fires. The idea is commendable, and should stimulate sellers of domestic electrical apparatus to make the whole of their exhibits self-explanatory.

The Rating of Machinery.—The Machinery (Rating) Bill, which is promoted by the Machinery Users' Association, is designed to amend the law relating to, and to secure uniformity in, the rating of hereditaments containing machinery. The preamble states that:—Whereas doubts have arisen as to how far machinery is to be included or taken into account in estimating the value for purposes of local rates of hereditaments occupied for trade, business or manufacture: And whereas the practice with regard to the estimating of such value is not uniform throughout England and Wales: And whereas the law relating thereto in England and Wales differs from the law in force in Scotland: And whereas it is desirable to secure uniformity of practice in England and Wales: It shall be enacted as follows:—

In estimating for the purpose of any local rate, or of the basis or standard thereof, or of any valuation list, the value of any hereditament occupied for any trade, business or manufacture, there shall be taken into account such machinery and plant only as is:—

(1) Fixed or attached to the hereditament and cannot be removed from its place without necessitating the removal of some part of the hereditament, or

(2) Used in or on the hereditament for producing or transmitting motive power or for heating, lighting or ventilating the hereditament.

Foreign Concessionary Companies in Constantinople.—The Commissioner of National Economy at Angora has issued orders to the authorities in Constantinople to apply the new regulations with regard to foreign enterprises in Turkey to all concessionary companies, as tramways, telephones, railways, &c.—*Reuter* (Constantinople).

A **Lighting Equipment Guide.**—As an aid to lighting contractors in placing before their customers suggestions for industrial and commercial lighting, the British Thomson-Houston Co., Ltd., has issued a wall sheet (L. 268) which illustrates a wide range of lanterns, reflectors, and other fittings. The sheet measures 40 in. x 30 in., is stiffened at top and bottom, and provided with a cord for hanging.

Norwegian Aluminium Works.—It is reported from Christiania that the Norsk Aluminium Co., which has entered into close relations with an American company for developing the industry in Norway, had 175 smelting furnaces in operation a year ago, and this number has since been largely increased. It is considered that the undertaking would have good prospects of competing with the big foreign rival works if it were possible to become independent of external sources of bauxite. Efforts to solve that problem in this direction are being made by the use of Labrador stone and Norwegian clay. Aluminium is also produced in Norway at the Vigeland installation near Kristianssand, and at Stangfjord, and by the Nitride Co. at Eydenhavn. The two former works are owned by English companies, and the latter by the French aluminium combine.

The A. E. U.—The annual statement of receipts and expenditure covering the year 1922 shows that the Amalgamated Engineering Union had an income of £1,029,592 (including £763,755 brought forward), and an expenditure of £187,674 (benefits £156,188 and administrative expenses £31,486), leaving a balance of £841,918. The figures include the value of investments, which at December 31st, 1922, was £831,806.

Lead.—Reporting on February 17th, Messrs. James Forster & Co. state that "sheet and pipe makers report quiet conditions and complain that consumers are not taking deliveries ex contracts. The electrical cable trade consumption is maintained, but is not increasing. Accumulator makers are not so busy. Board of Trade returns for January are: 19,867 tons imports and 2,255 tons exports, leaving no less than 17,612 tons for home absorption, or about 6,000 tons above average trade requirements (the biggest quantity since December, 1920, when the price of lead fell £10 a ton), again emphasising the evidence of previous months that there is no lack of lead for this country at any rate. In face of these figures the price has appreciated this year to the extent of about £2 a ton."

Industrial Administration.—Dr. C. C. Garrard (General Electric Co., Witton) addressed the Institution of Industrial Administration in Birmigham on February 14th. He stated that one of the most striking aspects of the development of modern industry was the application of what was known as "scientific method." By that was meant, that instead of applying the old qualitative methods of judgment, they used quantitative ones. In the domain of management they were passing from management by qualitative judgment to that of quantitative measurement. One cause of that was the increasing complexity of machinery and goods in general. To-day human work was so specialised that the connection between the individual's share of it and the final product was lost sight of. Hence, in order to avoid waste and misguided effort, an accurate control at all stages was essential. Industry to-day was carried on in a very wasteful manner. The measurement of human effort demanded the fixing of standards. It was difficult to over-estimate the importance of the costing departments in a works, but in many concerns the true elements of costing were not understood. The test of a proper cost and works bookkeeping system was that if at any time the works were totally destroyed and the books saved, it should be possible to tell exactly the financial position of the concern at the time of its destruction.

Applications for British Trade Marks.—The following are included among the recent applications for British trade marks. Objections are to be lodged within one month from the dates given:—

Chevrais (lettering and design). No. 424,570. Class II.—Electrical apparatus for the treatment of diseases of the skin. Mabel F. Fisher and Bertie H. Thompson, trading in copartnership, 149, St. John's Hill, Clapham Junction, London, S.W. February 14th, 1923.

Arada. No. 430,660. Class 18.—Bell systems, electric and pneumatic. Gent & Co., Ltd., Faraday Works, St. Saviour's Road East, Leicester. February 14th, 1923.

Macbeth Colour Identification Lamp (lettering and design). No. 425,388. Class 8.—A colour identification lamp for use in producing daylight effects. Arthur A. Dashwood Lang, 4, Vigo Street, London, W. February 14th, 1923.

Engineering Exhibits at Wembley.—We read in the monthly organ of the British Engineers' Association that the success of the Shipbuilding, Marine, Mechanical and General Engineering Sections of the Exhibition, being organised by the Association, is already practically assured. "Upwards of 170 British engineering firms, both big and small, already have applied for space, and the character of the exhibits indicated in the applications shows that the display will be fully representative of modern British engineering at its best."

Trieste Fair Destroyed by Fire.—According to newspaper reports three-quarters of the temporary buildings at the Trieste Fair have been destroyed by fire and the remaining buildings have had to be demolished to prevent the fire from spreading. The damage is estimated at two million lire.—*Reuter* (Rome).

E.D.A. Activities.—The latest publication of the British Electrical Development Association is a small card (E.D.A. 345) bearing a prophecy made by Emile Zola of the ultimate triumph of electricity, when it will become as necessary and as cheap to men as the air they breathe.

Australian Tariff Decisions. — The following tariff decisions have been approved by the Customs Department:—Electrical appliances and materials: Meters, watt-hour, alternating current. This decision is to apply only to such meters for which a firm order was placed prior to September 14th, 1922. Item 174, free, 5 per cent., 10 per cent.—*Reuter's Trade Service* (Melbourne).

Industrial Conciliation in South Africa.—During January the Union Government published the text of an Industrial Conciliation Bill, in which a new method of dealing with industrial disputes is put forward. The Bill provides for the constitution of Conciliation Boards consisting of equal numbers of employers and employés, not exceeding 12 in all, which shall be either standing or special boards—the latter to deal with specific disputes. The registration of trade unions and private registry offices is another feature of the measure.

Accumulator Charging.—MESSRS. J. W. BARNARD & HAYNES, LTD., the makers of the "J.W.B." accumulators, state that they will be glad to hear from traders in the London district who would be willing to receive accumulators at their addresses for collection by the firm's van, for charging.

Unemployment.—On February 5th, the number of workpeople registered at labour exchanges as totally unemployed was 1,386,000—a fall of 23,690 during the week. There was also a decline in the number of persons on "short time" from 54,674 on January 29th, to 52,800 on February 5th.

An Electrical Lunch.—On February 13th the members of the Scottish Electrical Contractors' Association who are participating in the Ideal Homes Exhibition, Edinburgh, entertained the Lord Provost of the city, and other municipal representatives to an electrically-cooked luncheon. Mr. D. S. Munro, the President of the Association, said that now electricity had done so much to eliminate smoke, soot, and gaseous fumes, they were in sight of the "ideal home." Gas had well served its day and generation, but now it should be used in the furnaces of electricity works. Lord Provost Hutchison agreed that a more general use of electricity would considerably benefit the public health. Mr. P. J. Ford, M.P., who was also a guest spoke of Swiss water-power development, and said that much could be done in this direction in the Scottish Highlands.

The World's Oil Supply.—The New York correspondent of *The Times* says that the Federal Trade Commission has submitted to Congress a report on foreign ownership in the petroleum industry of the United States, which is in effect an attack on the activities in that country of the Royal Dutch-Shell group. It questions the effectiveness of the Anti-Trust Laws in preventing the extension of the group's control over American producing fields.

The report asserts that the Royal Dutch-Shell controls over 11 per cent. of the world's output of petroleum in fields of production scattered over a wide area, whereas the American companies' sources of supply are limited to the United States and Mexico. It appears obvious, the report says, that a nation having widely distributed supply and storage facilities and owning the means of distribution will have advantages in world trade against one having a concentrated supply. A charge is made of discrimination by foreign Governments against American citizens in the petroleum industry in Australia, British North Borneo, certain African colonies, British Honduras, British Guiana, Trinidad, France and French possessions, Italy, and the Netherlands and dependencies.

For Sale.—Portsmouth Corporation Electricity Department has for disposal four Lancashire boilers, 3 ft. × 7 ft. 6 in. By direction of the Disposal Board, Messrs. Bradshaw Brown & Co. will sell by auction at the Royal Dockyard, Woolwich, S.E., on March 12th and following days, wireless material, electrical equipment, &c. (See our advertisement pages to-day.)

Social Events.—The first annual whist drive, dance and social of the staff and employés of the D. P. Battery Co., Ltd., was held in Bakewell Town Hall on Tuesday last week. The company present numbered about 300. One hundred took part in a whist drive, the prizes for which were distributed by Mr. J. Waddell, the manager of the company. There were brief speeches, including one from the oldest employé, Mr. R. Blackwell, who, on behalf of his fellow workers, presented Mr. Waddell with a walking stick and a smoker's cabinet as a memento of the occasion.

Salaries of Technical Staff.—According to the *Yorkshire Observer*, the Halifax Town Council recently decided to give a month's notice to the technical staff of the electricity department, together with an intimation that the Corporation was willing to re-appoint each member of the staff at a stated salary. The Electricity Committee has been informed, however, that the members of the staff are in the hands of the officials of their union, and cannot act independently. The Committee has, therefore, decided to withdraw the offer previously made, and has appointed an Emergency Committee which, with the manager of the electricity department, will take steps to fill the vacancies as they occur. It appears that the difficulty has arisen out of the inability of the District Joint Board for No. 2 (Yorkshire) area to carry out its normal functions, presumably owing to the action of the employer's side in withdrawing from the National Joint Board.

LIGHTING AND POWER NOTES.

Ayr.—JOINT ELECTRICITY BOARD.—The Town Council is applying to the Electricity Commissioners for an Order to constitute a Joint Electricity Board for Ayrshire. The other parties to the scheme are the Kilmarnock Corporation and the county of Ayr. The proposal is in connection with Ayr's Loch Doon scheme.

LOAN.—The Town Council has applied to the Electricity Commissioners for sanction to borrow £5,000 for electricity purposes.

Burton-on-Trent.—RELAYING MAINS.—The Town Council has decided to relay the mains in Station Street, which have been in use for 30 years, at a cost of £8,000.

Cardiff.—LOAN.—The Rural District Council has applied to the Electricity Commissioners for sanction to borrow £2,000 for electricity purposes.

Cheadle and Gatley. — PRICE REDUCTION.—The Urban Council has reduced the fixed charge for electricity supplied for power purposes from £4 per quarter per kW of maximum demand in a year to £2 10s.

ELECTRICITY ORDER.—The Council has decided, subject to the consent of the Cheshire County Council, to apply to the Electricity Commissioners for an Order authorising the Council to supply electricity in the Northern Etchells area.

Darlington.—LOAN.—The Town Council has applied to the Electricity Commissioners for sanction to a loan of £17,206 for extensions to mains.

Dorchester.—NEW PLANT.—The Town Council has instructed the borough surveyor to prepare plans and estimates for extensions to the electricity works needed for the installation of additional plant, and the Weymouth Town Council has been asked if its electrical engineer, Mr. Nicholson, can be permitted to advise on the additional plant needed.

Dronfield.—ELECTRICITY SUPPLY.—The Urban Council has approached the Sheffield Corporation with a view to obtaining a supply of electricity by overhead cables.

Felixstowe.—BULK SUPPLY.—The Town Council has decided to obtain a bulk supply of electricity from the Ipswich Corporation.

Glasgow.—EXTENSIONS TO DALMARNOCK STATION.—The Electricity Committee has recommended to the Town Council plans for the completion of the Dalmarnock power station. When the extensions are completed Dalmarnock will be one of the largest power stations in the country. It is expected that the work will occupy two years.

Glossop.—ELECTRICITY CHARGES.—The Urban Electric Supply Co. has obtained an order fixing the maximum charge for electricity at 10d. per kWh, with minimum payments of 12s. 6d. for the winter quarters and 8s. 4d. for the summer quarters.

Gravesend.—LOANS.—The Borough Council has approved a recommendation of the Electricity Committee to apply for sanction to borrow £15,765 for extensions at the electricity works. This is the balance of expenditure upon the installation of a 2,000-kW and a 5,000-kW turbo-alternator and boiler plant costing £60,346. Sanction is also to be sought for loans of £3,000 for mains and £7,000 for house services. In reply to criticism, the Mayor stated that last year the undertaking contributed £2,000 to the rates.

Grays.—BULK SUPPLY.—At a recent meeting of the Urban Council, the Electric Light Committee reported on its negotiations with the County of London Electric Supply Co. for a bulk supply of electricity. The Clerk explained that if the extensions to the Council's works were carried out it would involve a cost of £8,590. The bulk supply would cost £9,104. If the reduction which the company now offered was considered, the cost would be about equal. The Electricity Commissioners would agree to the extension of the Council's works only if it would cost less than the bulk supply.

Grimsby.—EXTENSIONS.—The Electricity Committee has recommended the Town Council to proceed with a scheme for extensions to the power station at an estimated cost of £75,000.

Hove.—NEW PLANT.—The Electricity Committee has recommended to the Town Council that, in order to meet the increased demand for electricity, new plant be installed at the electricity works. The estimated cost of carrying out the extensions is £33,500.

India.—SUTLEJ HYDRO-ELECTRIC SCHEME.—The Sutlej hydro-electric scheme, which has been put in hand, will give an output of 80,000 kW and will supply Delhi and Lyallpur, together with a number of intermediate stations. It is anticipated that the scheme will take five years to complete, and the estimated cost is Rs. 9 crores.

Irish Free State.—The Bann Power Scheme.—The secretary of the Ballymena Chamber of Commerce has, by request, furnished to the promoters of the River Bann power scheme a list of manufacturers, giving the approximate power required by each, the total being over 6,000 h.p. Similar lists are being given by other towns in the Bann area. At a recent meeting of Ballymoney Chamber of Commerce it was stated that the whole of Lough Neagh will be utilised as a reservoir. About £250,000 will be spent in dredging; a weir wall at Portna will cost about £55,000; and a second power station will be established at Carnor if the demand for electricity necessitates an increased supply.

London.—St. Marylebone.—The Highways Committee recommends the purchase of a motor generator, at the cost of £850, and a lighting set, at £350, for the Council's wharves.

Price Reductions.—The Westminster Electric Supply Corporation announces that, as from the March quarter meter readings, the following reduced tariff will be instituted:—Lighting: for the first 4,000 kWh per annum, 6d. per kWh; all consumption in excess of this amount, 4½d. per kWh; heating, cooking and power, 1½d. per kWh. The rates are subject to a minimum charge of 10s. per quarter.

Lothians.—Electricity Supply.—The surveyors of the National Electric Construction Co. have commenced laying the cable from the Edinburgh Corporation's power station at Portobello to the Lothians. The first line will supply a large sub-station near Monktonhall, Musselburgh, and it is expected that a supply from this source will be available in a few months.

Milnrow.—Electricity Supply.—The Electricity Committee has formed a small sub-committee to consider the tenders for the erection of the transforming station. With a view to embracing Newhey in the electricity scheme, a canvass is to be made of the district. To meet the needs of prospective consumers, cables are to be extended to the Firgrove and Heaton Street districts.

Paisley.—Electricity Supply.—The Town Council has adopted a report, submitted by the electrical engineer, on the proposed supply to the south and west districts of the town. The estimated cost is £20,000.

Plymouth.—Electricity Supply.—The Town Council has sanctioned the expenditure of £169,160 for the development of the electricity undertaking.

Preston.—Electricity Agreement.—The Town Council has entered into an agreement with the Blackburn Corporation, under which the two power stations will be linked up, and so obviate the need for duplicate sets in case of a breakdown.

Rye.—Electricity Scheme.—At a recent meeting of the Town Council an agreement was approved between the Corporation and Messrs. Crompton & Co., Ltd., for a supply of electricity. The company is to erect a generating station within 12 months and lay mains. The whole of the work is to be completed within 18 months. The maximum charge to private consumers is to be 1s. per kWh and 10d. per kWh for public lighting. The Council may acquire the undertaking by arbitration at periods of 15, 22, 29, or 36 years.

Sunderland.—Loans.—The Electricity Committee proposes to borrow £15,000 for laying new mains, £5,000 for re-cabling, and £2,236 for sub-station expenses. In addition to the last amount, £10,593 will be spent from revenue account in extending the Chester Road sub-station.

Warminster.—Inauguration of Electricity Supply.—The electricity undertaking was formally opened by the Marquis of Bath on February 17th.

Whitworth.—Loan.—The Council has applied to the Electricity Commissioners for sanction to the borrowing of £15,966 for the electricity scheme.

TRAMWAY AND RAILWAY NOTES.

Burnley.—Strike.—The fitters and turners at the tramcar shed, whose wages have been reduced by 5s. 6d. per week to the standard rate, threaten to cease work as a protest against the reduction.

Continental.—Switzerland.—It is anticipated that the electrification of the Swiss State Railways will be completed by 1928, i.e., five years earlier than was estimated in the scheme which was drafted in 1918. The electrical system, which will cover 950 miles, involves the use of 400 electric locomotives. If the traffic reaches pre-war figures, over half a million tons of coal will be imported yearly.—*Reuter* (Berne).

Russia.—The Yalta Executive Committee has proposed that an electric railway be constructed between Simferopol and Yalta.

A large power station is being constructed at the Kizcloff collieries near the Gubacha station of the Perm Railway. Its initial power will be 6,000 kW, from two turbo-generators of 3,000 kW each. The pressure will be transformed to 38,000 volts for supplying the mines.

A site is being selected for a power station near Tchelyabinsk to supply electrical energy to a number of factories in Central and Southern Ural. Coal from the local mines will be used.

A special expedition is being organised to investigate the Olonetz district (North Russia) rivers for hydro-electric purposes.

Derby.—Penny Fares.—The Town Council has introduced penny fare stages on its tramway system.

Harefield.—Light Railway.—The Ministry of Transport has made an Order authorising the construction of light railways in the parishes of Harefield, Hillingdon East, Uxbridge, and Denham.

Huddersfield.—New Route.—The new tramway route to Brighouse has been completed as far as Rastrick. The cost of the track, which it is anticipated will be in operation by March, is somewhat below the original estimate of £70,000.

Hull.—Track Renewals.—The Tramway Committee proposes to renew certain portions of the tramway track at an estimated cost of £117,155. The work will be extended over a period of two or three years.

Japan.—Tokio.—A preliminary contract has been signed with the Foundation Co. of New York for a network of underground railways. The first section of the scheme provides for the construction of four miles of tubes, at a cost of £3,000,000. The estimated cost of the whole scheme is £8,000,000.

London.—Traffic Return.—The London Underground Companies announce that £1,334,000 was expended during the year in the provision of new rolling stock, constructional improvements, and extensions of the railways. The companies are committed to an expenditure of £17,000,000 for improvements in Greater London traffic facilities.

Underground "Speed Up."—Commencing on February 19th, the Underground Co. made improvements in the train services on the District Railway, additional early morning trains having been introduced.

North-Eastern Railway Co.—Annual Report.—The report for the year ended December 31st, 1922, shows that out of a total of 40,366,777 engine miles run by the company's stock, electric traction accounted for 951,229 engine miles. The company now has 13 electric locomotives, 71 electric motor vehicles, and 55 trailer cars, as compared with steam stock comprising 1,384 tenders, 447 tank engines, and 312 shunting engines.

Northern Ireland.—Railway Electrification.—A scheme is under consideration for the electrification of the Belfast and County Down Railway, which connects that city with the towns of Bangor, Newcastle, Donaghadee, and other watering places.

Plymouth.—Doubling of Track.—The Corporation has decided to double portions of the tramway track in Wolseley Road and King's Road at an estimated cost of £39,516.

Railway Electrification.—S.E. & C.R.—The electrification of the suburban lines of the above section of the Southern Railway will, according to the daily Press, be commenced next month. The lines will include the routes from Charing Cross to Dartford and Orpington, a distance of 15 miles. Other routes are to be electrified later.

West Hartlepool.—Railless Cars.—The Corporation has under consideration a scheme for running railless cars on the Foggy Furze route. The estimated cost of carrying out the scheme is £10,000. This scheme is suggested as an alternative to relaying the present track, which would cost £40,000.

TELEGRAPH & TELEPHONE NOTES.

China.—Chiao Tung-Pu (the Ministry of Communications) has informed the Diplomatic Body that as all the telegraph, telephone, and radio buildings and installations throughout the country are absolutely public property, no one is entitled to sell or mortgage them, and that if the provincial authorities or foreign interests enter into any such agreements the Government will not recognise their validity.—*Reuter.*

Finland. — Helsingfors Automatic Exchange. — The directors of the Helsingfors (Finland) Telephone Association report having entered into a contract with a German firm (Siemens & Halske) for the supply of an automatic telephone exchange for from 20,000 to 30,000 subscribers; the work will be carried out in stages and the first instalment will consist of 2,000 lines. The latter is expected to be brought into use in the summer of 1924.

India. — Broadcasting. — The Indian Government has decided to permit private enterprise to undertake radio broadcasting in British India and Burma upon similar lines to those obtaining in the United Kingdom. It is proposed to ascertain whether similar arrangements could be made in India to form a company, open to both British and Indian manufacturers of receiving apparatus. The Government is, accordingly, con-

vening a conference, to be held at Delhi on March 7th, under the presidency of the Director-General of Posts and Telegraphs, to discuss preliminary details, and manufacturers and others who desire to undertake broadcasting are invited to attend. The Government is also issuing a draft form of licence.—*Reuter.*

New Atlantic Cable.—Correction.—Our last week's note under the above heading has been read as an announcement of the laying of a new Atlantic cable. Such an impression, however, is incorrect, as no new cable has been laid. Hitherto direct communication between London and New York only has been maintained by means of several cables. Arrangements have now been made by which a new circuit has been established direct between London and Boston by means of an existing cable.

Radio-telephony.—Broadcasting.—The sixth radio-telephone broadcasting station to be established in this country was to have commenced to function at Port Dundas, Glasgow, on February 19th with the call signal 5 M G, and a wave length of 440 metres.

Reception on Moving Vehicles.—The possibility of wireless telephony on express trains for the entertainment of passengers was demonstrated recently by the Marconi Co., by permission of the London, Midland, and Scottish Railway Co., on a train between Euston and Liverpool. A special saloon, fitted with outside and inside aerials, gave excellent results—even as it passed through the tunnel. Further on, however, the dynamo used for the electric lighting of the train caused interference, and the outside aerial had to be abandoned, but with the frame or inside aerial good results were achieved. It was raining heavily at the time. No interference was experienced from passing trains.

The Telephone Service.—New Exchange.—A new telephone exchange was opened at Rock Ferry on Saturday to supersede the existing exchange, which can no longer cater for the needs of the neighbourhood. The exchange is of the common battery type, and nearly a thousand subscribers can be accommodated, while further extensions can be made, when necessary, to provide for service for two thousand subscribers.

Automatic Equipment.—There are 16 public automatic exchanges already in service in this country, with an ultimate capacity of 50,000 lines, and development of the system is proceeding rapidly. In fact, it is understood that it has been decided to develop the telephone system in the future largely on automatic lines. New exchanges are in course of installation in six towns, and the equipment at four other places is being extended. Orders for automatic equipment will shortly be placed for exchanges in 10 towns, and preliminary arrangements for buildings and plant specifications have been taken in hand with respect to 26 additional areas.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review in which the "Official Notice" appeared.)

OPEN.

Argentina.—Buenos Aires.—April 26th. Department of Sanitary Works. Nineteen groups of vertical centrifugal pumps, with electric motors and spare parts.

A copy of the specification is expected to reach the Department of Overseas Trade about the end of the present month.

Australia. — Melbourne. — Postmaster-General's Department. 16,750 Leclanché porous cells and 1,200 earthenware outer jars.*

March 1st. Telephone and telegraph parts. March 16th. Telephone and switchboard parts and wires. March 21st. Testing and protective apparatus. April 9th. Telegraph and telephone material. April 10th. Bronze and copper wire. April 11th. Positive plates for storage batteries. April 17th. Covered wires. April 18th. Telephone apparatus. April 24th. Telephones and handsets and switchboard cable. (February 16th.) April 3rd. 5,100 telephone-receiver diaphragms.* April 10th. 686 tons bronze wize, &c.* April 17th. 400,000 copper jointing sleeves, 595 timing clocks.*

March 28th. Victorian Railway Commissioners. Two sets of 3-ph., 20 b.h.p. induction motors, starting apparatus, and accessories; one 20-b.h.p. d.c. motor, starting apparatus and accessories.* April 4th. Electric hoist, with trolley.*

Sydney.—April 30th. Amalgamated Wireless (Australia), Ltd. Tenders for modern wireless service between Australia and England and between Australia and Canada. Supply, delivery, and erection complete and ready for operation of a high-power duplex station within 100 miles of Sydney or Melbourne capable of direct communication with England 24 hours daily throughout the year. Suitable corresponding duplex stations to be provided in England and Canada. The secretary, 97, Clarence Street, Sydney.

Barking.—March 12th. County of London Electric Supply Co., Ltd. Condensing plant and auxiliary apparatus for the Barking power station. (February 9th.)

March 26th. Static transformers. (February 9th.)

Bedford.—March 13th. Electricity Department. Supply of e.h.p., h.p. and l.p. underground cables for 12 months. (See this issue.)

Belfast.—March 10th. Electricity Department. Stores (including many electrical items) for six or twelve months. (February 16th.)

March 12th. 3-ph., h.p., a.c. switchgear for sub-station. (February 16th.)

March 6th. Tramways Committee. Six or 12 months' supply of tramways stores, including several electrical items. (February 16th.)

Belgian Congo.—The Belgian Ministry of the Colonies has recently invited offers for the establishment and working of an electricity supply undertaking at Stanley Pool, in the Congo (Kasai).

Belgium.—February 28th. Belgian Post and Telegraph authorities, La Salle Madeleine, Brussels. Seven lots of bronze wire. Particulars for 1 fr. 70 c.

March 15th. Municipal authorities of Beaufays (Province of Liége). Electrically-operated pump in connection with the local water supply. Particulars from the Maison Communale.

April 18th. Ministry of Railways, Marine, Posts and Telegraphs. Supply and installation of telephone equipment for Antwerp.*

Birmingham.—March 5th. Education Committee. Motor generators, transformers, and switchgear, for the Municipal Technical School. (February 9th.)

China.—Tientsin.—March 12th. Peking-Mukden Railway. Electric signalling material. Specification from Mr. C. P. Sandberg, 40, Grosvenor Gardens, S.W.

Darlington.—March 7th. Electricity Department. One water-tube boiler. (February 16th.)

Dublin.—March 12th. Irish Free State Postmaster-General's Department. 14 tons bronze wire. (See this issue.)

Edinburgh.—March 13th. Electricity Supply Department. Two 4,500-kW, 3-phase or alternatively single-phase transformers. (See this issue.)

Egypt.—Cairo.—March 22nd. Egyptian State Railways. Water-tube boiler, h.p. cables, switchboard panel and transformers for the electric power house, Gabbary. Specifications from Stores Department, Saptia (Cairo), or Gabbary (Alexandria), and at the office of the Administration's Inspecting Engineer in London, Major J. S. Liddell.

Director, Section of the Municipalities and Local Commissions, Savoy House, Cairo. Extension of the electrical system at Zagazig.—*Reuter's Trade Service* (Cairo).

London.—St. Marylebone.—February 28th. Electricity Department. Suction and discharge pipework and valves, h.p. steam pipework and valves, ash-handling equipment, electrically-operated jib crane or transporter equipment, e.h.p. and l.p. switchgear, annual supplies of underground cables. (February 9th.)

Fulham.—February 28th. Electricity Department, Twelve months' supply of electrical and engineering stores. Particulars from the Town Hall.

Shoreditch.—The Borough Council Lighting Committee will shortly invite tenders for boiler and converting plant.

Battersea.—March 8th. Electricity Department. One 1,800-kW rotary converter and switchgear. (See this issue.)

Manchester. — February 27th. Tramways Committee. Tramway stores. H. Mattinson, general manager, Corporation Tramways, 55, Piccadilly, Manchester.

Morocco.—Mogadore.—March 1st. The Town Council of Mogadore is inviting tenders for a concession for 53 years to supply the town with electricity. Particulars, Chef des Services Municipaux, Mogadore.

New Zealand.—Wellington.—March 20th. P. W. Department. 400 miles h.d. copper wire.*

Nottingham.—March 1st. Tramways Committee. 300 tons of steel tramway rails. Mr. T. Wallis Gordon, city engineer and surveyor.

Oldham.—March 7th. Corporation Carrying and Cleansing Committee. Refuse disposal plant, including electric motors, for Rhodes Bank destructor depôt. Specifications from Mortimore, Lyon & Co., Mansfield Chambers, St. Ann's Square, Manchester.

Portsmouth.—March 6th. Town Council. Electrically-operated jib crane. Mr. A. Ward, borough engineer.

Rumania.—Galatz.—Supply of two generating sets complete, including Diesel motors, 325-h.p. d.c. dynamos and exciters. Particulars, Comptoir Commercial Française, 73 bis, Rue du Général Berthelot, Galatz.

South Africa.—Johannesburg.—March 5th. South African Railways and Harbours Board. Electrical cables and bare copper wire.*

Pretoria.—March 14th. Government Posts and Telegraph Department. Insulators, copper and braided wire, &c.*

Stoke-on-Trent.—March 7th. Electricity Department. Step switch resistance. (February 16th.)

Tilbury.—February 24th. Urban District Council. Electric vehicles for collection of refuse, and plant for charging them. Mr. S. A. Hill-Willis, engineer to the Council.

Torquay. — February 26th. Electricity Department. Four 3-ph. to 2-p.h. transformer groups. (February 9th.)

Weymouth.—March 10th. Electricity Department. One 350-kW vertical gas engine and dynamo, with gas plant. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Belfast.—Corporation. Accepted: —
Three rotary converters.—English Electric Co., Ltd. (£8,091); Metropolitan-Vickers Electrical Co., Ltd. (£8,195); British Thomson-Houston Co., Ltd. (£8,078).

Corporation. Public Health Committee. Accepted:—
Electric lighting installation at the Infectious Diseases Hospital, Purdysburn (£220).—D. Gamble & Co., Ltd.—*Irish Builder and Engineer.*

Belgium.—Six tenders—three Belgian and one each Dutch, French, and British (Callender's Cable and Construction Co., Ltd.)—were recently submitted to the municipal authorities of Schaerbeek, Brussels, for the supply of 18,500 metres of high- and low-pressure armoured cable, the lowest offer being that of the Société des Ateliers de Constructions Electriques, of Charleroi.

The municipal authorities of Hognout recently invited offers for the concession for the supply of electricity for lighting and power purposes in the town. Only one was received, that being from the Société d'Electricité de Seraing et Extensions, of Brussels.

The Metropolitan-Vickers Electrical Co., Ltd., was last week successful in submitting the lowest tenders for the supply of several large lots of insulators for the Belgian State railway authorities in connection with the electrification of the railway system.

The Belgian Post and Telegraph authorities in Brussels last week divided some large contracts for miscellaneous telephone material between the New Antwerp Telephone and Electrical Works, Antwerp, the Bell Telephone Co., Antwerp, and the Société, Electrique et Mécanique, Brussels.

Canada.—With further reference to our note on p. 262, ELEC REV., February 16th, the order placed by the Winnipeg (Canada) Municipal Corporation with Messrs. James Howden & Co., Ltd., is for two 5,000-kW turbo-alternators and one 1,000-kW ditto at a cost of about £50,000. In addition, the firm has secured a China contract for one 1,000-kW turbo-alternator for a sugar factory; and one from the Victorian Government for a 1,500-kW turbo-alternator. It is stated that many firms in this country and America had tendered for the Winnipeg contract, which is the first of any magnitude for this type of plant to be placed by Canada since the early part of 1914.

Chelmsford.—Joint Hospital Board. Accepted:—
Installing the electric light at the hospital (£159).—Mr. Elnaugh.

Darlington.—Town Council. Accepted:—
Cables (£7,396).—British Insulated and Helsby Cables, Ltd.

Glasgow.—Tramways Committee. Recommended.
Handrail for pumps at Pinkston power station.—P. & R. Fleming and Co.
Lifting gear for condensers at Pinkston.—North British Lifting and Moving Appliance Co., Ltd.
Trolley bushes.—British Insulated and Helsby Cables, Ltd.
Asbestos covering of steam pipes at Pinkston.—Bell's United Asbestos Co., Ltd.
Steel tires.—Steel Co. of Scotland, Ltd.
Lead-covered telephone cable.—Western Electric Co., Ltd.
Lead-covered e.h.p. cable.—English Electric and Siemens Works Co., Ltd.

Special Committee on Housing. Accepted:—
Electric lighting installation at Pollokshaws housing scheme (£212).—R. J. Sinclair.

Government Contracts.—The following Government contracts were placed during January, 1923:—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.
Accumulators.—Fuller's United Electric Works, Ltd.
Distributing and supply boards.—General Electric Co., Ltd.
Electric capstans.—Cowans, Sheldon & Co., Ltd.
Inert cells.—Fuller's United Electric Works, Ltd.
Secondary cells.—Fuller's United Electric Works, Ltd.
Electric lift.—W. Wadsworth & Sons, Ltd.
W/t. masts.—C. F. Elwell, Ltd.
Electrically-driven rolling mills.—J. Robinson & Co., Ltd.
10-ton electric traveller.—Cowans, Sheldon & Co., Ltd.

WAR OFFICE.
Mechanical stokers and gear.—Babcock & Wilcox, Ltd.
Electric hay-baling presses.—Hindle, Son & Co.
Electric torches.—General Electric Co., Ltd.

AIR MINISTRY.
W/t. apparatus.—Park Royal Engineering Works, Ltd.
Components for w/t. masts.—Bullers, Ltd.
Aerial copper wire.—W. T. Henley's Telegraph Works Co., Ltd.
Gear for w/t. masts.—F. Dobbin & Co.

CROWN AGENTS FOR THE COLONIES.
L.p. cable, &c.—Callender's Cable and Construction Co., Ltd.
Porcelain insulators.—Doulton & Co., Ltd.
Electric passenger lifts.—W. Wadsworth & Sons, Ltd.
Electric motors and control gear.—Brush Electrical Engineering Co., Ltd.
Telegraph poles.—Bullers, Ltd.

POST OFFICE.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Testing, protective apparatus.—Evershed & Vignoles, Ltd.; Siemens Bros. and Co., Ltd.
Distributing boards.—W. Sanders & Co.
Submarine cable.—Siemens Bros. & Co., Ltd.
Telegraph and telephone cable.—Enfield Ediswan Cable Works, Ltd.; General Electric Co., Ltd.; Heckbridge Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Pirelli-General Cable Works, Ltd.; Union Cable Co., Ltd.
Porous Leclanché cells.—General Electric Co., Ltd.
Telephone cords.—British Insulated and Helsby Cables, Ltd.; Phœnix Telephone and Electric Works, Ltd.; Western Electric Co., Ltd.
Ducts.—Albion Clay Co., Ltd.; Donington Sanitary Pipe and Firebrick Co., Ltd.; Hepworth Iron Co., Ltd.; G. Jennings, Oates (Thornton), Ltd.
Switchboard lamps.—General Electric Co., Ltd.
Telegraph poles.—Burt, Boulton & Haywood, Ltd.
Paper sleeves.—S. O'Neill & Sons, Ltd.
Spindles.—Bullers, Ltd.; Horton & Sons, Ltd.; Universal Bolts and Nuts, Ltd.
Stay swivels.—Bullers, Ltd.
Creosoted wood troughing.—Burt, Boulton & Haywood, Ltd.; Calder and McDougall, Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.
Enamelled and single silk-covered copper wire.—Concordia Electric Wire Co., Ltd.
H.d. copper wire.—T. Bolton & Sons, Ltd.; British Insulated and Helsby Cables, Ltd.; Enfield Ediswan Cable Works, Ltd.; Wilkes, Son and Mappleback, Ltd.
Leclanché zinc rods.—Lockie Lancaster and W. W. & R. Johnson & Sons, Ltd.
Batteries.—Newport (Mon.) Telephone Exchange: D. P. Battery Co., Ltd.
Manufacture, supply drawing-in and jointing cable.—Colchester-Ipswich: Pirelli-General Cable Works, Ltd.
Telephone exchange equipment.—(Accrington): Automatic Telephone Manufacturing Co., Ltd.; (Blackpool): Automatic Telephone Manufacturing Co., Ltd.; (Liverpool, Old Swan): British L. M. Ericsson Manufacturing Co., Ltd.; sub-contractors: Chloride Electrical Storage, Ltd., for batteries; Crompton & Co., Ltd., for machines.

H.M. OFFICE OF WORKS.
Engineering services.—Supply of electrical labour, Bristol district.—R. Whipp & Co. Teddington Laboratory cables.—Siemens Bros. & Co., Ltd.

India.—Clayton Wagons, Ltd., Lincoln, has an order in hand for a fleet of eight 5-ton electric motor wagons for the collection of refuse for the municipal authorities of Calcutta. The vehicles are equipped with light cranes, so that the street receptacles may be easily and quickly tipped into the end-tipping bodies.

London.—The Synchronome Co., Ltd., has secured the contract for installing its electric clock system in the Bush Terminal Co.'s building, Bush House, Strand.

SHOREDITCH.—Lighting Committee. Accepted:—
Renewal of telephone installation and apparatus and wiring for same (£343).—Western Electric Co., Ltd.

Manchester.—Education Committee. Accepted:—
Electric light installations:—Nelson Street School, Arnold Electrical Co.; Vine Street and Queen Street Schools, Seddon & Sons; Upper Lloyd Street School, Maitland & Co.; Webster Street School, Sudlow and Co.; Holland Street School, Power & Lighting Supplies Co., Ltd.; Christ Church School, Hulme, Ward & Booth.

Electricity Committee. Accepted:—
One 2,500-kW lighting converter and one 2,500-kW traction converter.—Bruce Peebles & Co., Ltd.
Reconstruction of two 3,000-kVA transformers.—Ferranti, Ltd.
Extensions to the overhead transmission system, Blackley Estate.—Twiss Electric Transmission, Ltd.
One 1,500-kW and one 1,000-kW rotary converters and transformers.—Mather & Platt, Ltd.; sub-contractors for transformers, Ferranti, Ltd.
Two 500-kW automatic rotary converting sets for lighting and power.—British Thomson-Houston Co., Ltd.; sub-contractors for transformers, Brush Electrical Engineering Co., Ltd.
One 500-kW automatic rotary converting set.—Metropolitan-Vickers Electrical Co., Ltd.
One 500-kW automatic converting set for traction.—A. Reyrolle & Co., Ltd.; sub-contractors for the motor converter, Bruce Peebles & Co., Ltd.

Sunderland.—Town Council. Accepted:—
Tramway points.—Hadfields, Ltd.
Wheel tires.—Steel, Peech & Tozer, Ltd.

Watford.—Town Council. Accepted:—
Extensions to the electricity works (£16,315).—Industrial Construction Co., Ltd.

FORTHCOMING EVENTS.

Royal Institution of Great Britain.—Saturdays, February 24th and March 3rd. At Albemarle Street, W. At 3 p.m. Lecture on "Atomic Projectiles and their Properties," by Sir Ernest Rutherford, F.R.S.
Thursday, March 1st. At 3 p.m. Lecture on "Water Power of the Empire," by Mr. T. Stevens.

University of London.—Monday, February 26th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 5.15 p.m. Lecture on "The Control of the Speed and Power Factor of Induction Motors," by Prof. Miles Walker. (Lecture II).

Institution of Mechanical Engineers.—GRADUATES' SECTION.—Monday, February 26th. At the Institution, Storey's Gate, S.W. Annual lecture: "Photo-Elasti-metric Researches on Mechanical Engineering Problems," by Prof. E. G. Coker, F.R.S.

National Association of Supervising Electricians and Association of Engineers-in-Charge.—Tuesday, February 27th. At St. Bride's Institute, Ludgate Circus, E.C. At 7 p.m. Joint lecture, "Preparation of Estimates, Specifications and Contracts for Electrical Work," by Mr. W. E. Highfield, Mr. A. Kirk, and Capt. A. E. Penn.

Industrial League and Council.—Wednesday, February 28th. At Caxton Hall, S.W. At 7.30 p.m. Lecture on "Fundamental Causes of Unemployment," by Mr. H. G. Williams.

Royal Society of Arts.—Wednesday, February 28th. At John Street, Adelphi, W.C. At 8 p.m. Paper on "Heat Resisting Glasses," by Prof. W. E. Turner.

Chemical Society.—Thursday, March 1st. At Burlington House, W. At 8 p.m. Ordinary Scientific Meeting.

Chelmsford Engineering Society.—Thursday, March 1st. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Combined Gas and Electricity Undertakings," by Mr. A. H. Seabrook.

Institution of Electrical Engineers.—Thursday, March 1st. At the Institution, Victoria Embankment, W.C. At 6 p.m. Report presented on behalf of the British Electrical Research Association by Messrs. S. W. Melsom and E. Fawssett on "Permissible Loading of British Standard Paper-insulated Electric Cables."
INFORMAL MEETING.—Monday, February 26th. At the Engineers' Club, Coventry Street, W. At 8 p.m. Smoking concert.
(South-Midland Centre).—STUDENTS' SECTION.—Tuesday, February 27th. At the Queen's Hotel, Birmingham. Smoking concert.

Institution of Electrical Engineers (Scottish Centre).—Friday, March 2nd. At the Central Station Hotel, Glasgow. At 7 p.m. Annual dinner.

(North-Eastern Centre).—Monday, February 26th. At the Armstrong College, Newcastle-on-Tyne. At 7.15. Special meeting; paper on "Some Problems in High-speed alternators and their Solution," by Mr. J. Rosen.

(North-Midland Centre).—Tuesday, February 27th. At the Queen's Hotel, Leeds. At 7.15 p.m. Visit of the president, Mr. F. Gill.

Junior Institution of Engineers.—Friday, March 2nd. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Glass Forming Machines," by Mr. O. Saxton.

Birmingham and District Electric Club.—Friday, March 2nd. At the Grand Hotel, Colmore Row. At 6.30 p.m. Annual dinner.

Electrical Power Engineers' Association.—Friday, March 2nd. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 7 p.m. Lecture on "High Power Mercury Arc Rectifiers with special reference to Traction Service," by Mr. R. L. Morrison.

British Electrical Development Association.—Friday, March 2nd. At Caxton Hall, S.W. At 7.30 p.m. Paper on "The Industry, The Press, and The Public," by Mr. A. Gowans Whyte.

REVIEWS.

The Construction of Wireless Receiving Apparatus. By PAUL D. TYERS. Pp. vii+76; figs. 28. London: Radio Press, Ltd., and Pitman & Sons., Ltd. Price 1s. 6d. net.

Wireless Valves simply Explained. By JOHN SCOTT-TAGGART. Pp. v+134; figs. 56. London: Radio Press, Ltd., and Pitman & Sons, Ltd. Price 2s. 6d. net.

These two books may reasonably be reviewed together as they are to a great extent complementary and both are certain to be added to the library of the wireless enthusiast. Both books are intended for the amateur or beginner but, whereas Mr. Tyers's book is essentially practical in nature and will appeal primarily to those who wish to make their own apparatus, Mr. Scott-Taggart's volume will appeal alike to the practical man and to him who purchases a ready-made set. In both cases the authors have adhered closely to the stated plans of their books, and have thus been able to give a maximum of relevant information in minimum space.

No attempt is made in Mr. Tyers's book to explain fully the functions of the various pieces of apparatus, but the general purpose of each is stated and any reader who has acquired sufficient knowledge of the main principles of wireless to be in a position to commence the construction of apparatus will have no difficulty in following this treatise. In it he will find clear and concise instructions of an essentially practical nature for the construction of anode and grid resistances, filament rheostats and potentiometers, inductances, filament batteries, anode batteries, condensers and detectors. The illustrations are exceptionally clear, ample information is given concerning materials and dimensions, and (what will particularly inspire confidence) every component described has been tested thoroughly by the author and by a number of his friends. Detailed information is given as to how to make all the parts of a valve or crystal set; more than one method is described for the making of various components, and in no case does the method described require the use of a lathe or expensive tools. In fine, this book embodies every essential to the success of the reader and is therefore itself assured of success. We know of no other book at once so inexpensive, comprehensive, and directly useful to the readers for whom it is intended.

The construction of thermionic valves themselves is, of course, technically and economically beyond the capabilities of the amateur, and these devices are invariably bought "ready-made." In order to obtain the best results it is essential to use the valves intelligently and this demands a knowledge of their theory and action. The rudiments of the subject are presented very clearly in Mr. Scott-Taggart's book which is designed so as to be intelligible to those with no previous knowledge in this field. The book is sufficient for the requirements of the amateur who wishes for a general understanding of a purchased set or who wishes to try various combinations of purchased or home-made components and, at the same time, it affords an excellent introduction to the study of more advanced works by those who are taking up the subject seriously.

Alternative methods of tuning are first discussed, with examples, and the action of the two-electrode valve is then explained. The construction, characteristics, and applications of the three-electrode valve are then considered. The next chapter deals with cascade valve amplifiers and leads up to the consideration of reaction amplification and self oscillation. Chapters VI and VII deal respectively with the reaction reception of wireless signals and with continuous wave receiving circuits, after which there are two chapters on valve transmitters and the use of valves in the transmission of wireless telephony. Finally, the special requirements of wireless broadcast receivers are considered, with special reference to the avoidance of reaction or self-oscillation effects. It will be seen that this book is equally valuable to those who have a complete transmitting and receiving equipment and to the much greater number who have only a receiving set.

Sharing Profits with Employés. By JAMES A. BOWIE, M.A. (Pitman's Industrial Administration Series, edited by A. P. M. Fleming, C.B.E., M.Sc., M.I.E.E.) Pp. x+222; +11. London: Sir Isaac Pitman & Sons. Price 10s. 6d. net.

We dealt in our leading article of December 29th, 1922, with the question of the reward of industry, and in the course of that article we mentioned that the general trend of the book now under notice was in the direction of contributory co-partnership. The desirability of giving the worker an interest, or the opportunity of obtaining an interest, or both, in the prosperity of his employer, is recognised in many quarters. The notion that it would be disadvantageous to the workers as a whole that some of them should be reluctant to leave their employers because of such interest, is fantastic, and is only held by a small minority who have other objects in mind than the promotion of the country's welfare.

For the actual work that they do, workers are paid salaries or wages, and the wages are either by time or by the piece. An increase of effort all round ought, in normal circumstances, to result in an increase of profit, and such increase of effort ought to meet with its reward in the shape of an increase of remuneration. Here we have the germ of such schemes as that of Messrs. Priestman Bros., Ltd., which has been several times dealt with in our columns. Any increase of output over the standard that has been fixed, brings an increase of pay for the four weeks next following. The bonus is offered as an inducement to increase the productivity of the undertaking.

Mr. Bowie argues that "every industrial innovation must justify itself on one of two grounds: Either it must sweeten social relationships or promote the efficiency of production." He arrives at the conclusion that cash profit-sharing does not meet either of these requirements. The trouble seems in most cases to have been that the results obtained are insignificant. A bonus paid annually, whether based on turnover, output, profit, or increase of profit, must be something of sufficient value to interest the recipient. It should not, like some notorious examples we have known, be part of a worker's proper earnings, withheld for a year and limited to some proportion of his salary. There should be no upper limit to the earning capacity of an employé. It is the attempt—too often successful—to impose a limit of this character, that has been the most direct contributory cause of the widespread dissatisfaction that has existed among the salaried workers, and of ca' canny and restriction of output among the operatives.

The personal experience of the present reviewer leads him to disagree with Mr. Bowie's conclusion that the free distribution of shares is "demoralising" (p. 106). Properly carried out and safeguarded, the bestowal of a few shares once a year is neither regarded as a right, nor as charity, nor as saddling the recipient with an undesirable responsibility. We agree that it is right that it should be made easy for employés to buy shares, and that they should have opportunities and facilities greater than those that are available to the ordinary purchaser. If not, what inducement is there to invest money in one undertaking rather than in another? And the hypothesis is that the worker is to be given the means of obtaining an interest in the prosperity of his or her own employer.

Mr. Bowie seems to fear that what is given for nothing may be valued at its cost—nothing. The fallacy here is that the bonus, whether it take the form of cash or of shares, is not given for nothing, but for assisting to the utmost in promoting the business. Shareholding is not restricted to the brainiest or the wisest in the community, and there seems no reason for specifying such a requirement in the case of employé-shareholders.

We regret to find, after a careful reading of this book, that there remains in the mind a suspicion that Mr. Bowie is "talking down" to his readers. Why else should a Master of Arts employ, particularly in the earlier parts of the book, such a horribly colloquial style? It is obviously not because he does not know any better. Does he think his readers do not?

There is authority for treating the expression "The Government" as singular, and there is the Government's own authority, as shown in official utterances, for regarding it as plural. It is, however, desirable that one or the other, and not both be adopted: but Mr. Bowie, on page 17, says "the Government makes," in line 6, and "the Government have" in line 22. It is incorrect to state that "capital originally represented accumulated savings" (p. 157). Savings out of what? Profits, says Mr. Bowie. Then profits out of what? The original capital is the earth, the planet we inhabit, and we have said over and over again that only by the application of labour to the land (or the sea) can wealth be produced. We know what Mr. Bowie means, of course, but it behoves those who set out to guide their fellows to be careful, and not to write in a slipshod manner.

There is much more that could be written about the book, and about the subject with which it deals, but we are reaching the limits of our space. We like Mr. Bowie's method of summarising each chapter and presenting its arguments in a nutshell; and the book is well indexed. It is a serious contribution to thought upon this important problem, and we hope that, if there is a second edition, it may be purged of what we regard as its defects, so as to fulfil its function in a manner worthy of its subject and of its author.

A B.T.H. ELECTRIC ROLLING-MILL INSTALLATION.

Speed Regulation of Strip and Bar Mills.

Practically all merchant and bar mills are required to roll a large variety of products; even those designed for a large tonnage are called upon to handle weights which vary in the ratio of 10 to 1, while ordinary mills are required to greatly exceed this weight ratio. Combined with this factor, the fairly definite speed, which exists for each particular product, at which the mill will roll the maximum tonnage necessitates the speed of the mill motor being adjustable. In addition to the usual characteristics required for mill motors generally, it is essential also, when motors for these mills are adjusted for any definite speed throughout the range of control, that this speed should be only slightly affected by wide variations in load. The motor should be capable of carrying high overloads throughout the full-speed range, and its efficiency should be highest for the particular range of speed required for the maximum rate of production. Added to these features, it is also essential that the power factor should be high and that the cost of such a motor should not be excessive.

Fig. 1.—Merchant Mill Stands.

The method most widely used for such speed control to-day is a modification of the Scherbius system adopted by the General Electric Co., of America, which meets every requirement of rolling mill drives.

As an installation of this type, the first of its kind in Europe, the electrical equipment of the new 12-in. merchant and 10-in. strip mills at the Templeborough works of the United Strip and Bar Mills, Ltd., is of exceptional interest. In this case the double-range modified Scherbius system permits speed control of the main motor below, at, or above, synchronism and up to such limits as are determined by the capacity of a regulating machine; it also provides for improvement of the power factor under the various conditions of load and speed regulation and, it is claimed, constitutes the most generally efficient control scheme yet devised for induction motors.

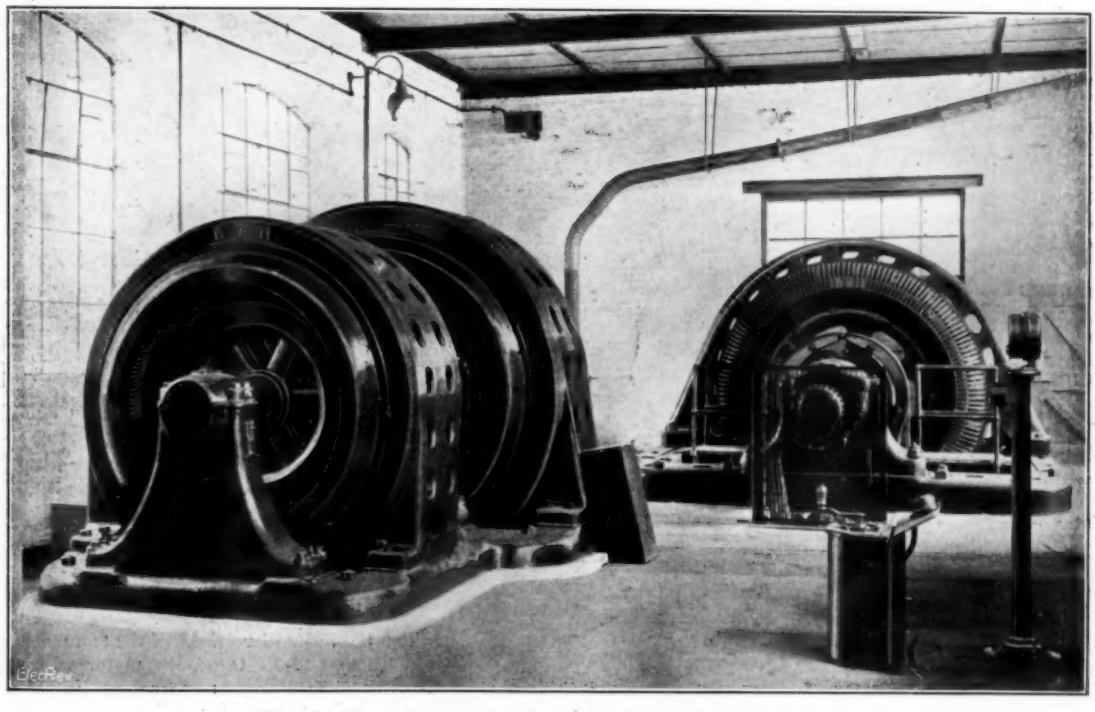


Fig. 2.—Main Merchant Mill Motor and Regulating Set.

The electrical equipment of these mills, which was

supplied by the British Thomson-Houston Co., Ltd., Rugby, consists of a:—

Main 12-in. merchant mill induction motor developing 3,000 h.p. at 470/375/280 r.p.m., with its 375-r.p.m. regulating set, comprising a 950-kW a.c. commutating machine and a 775-h.p. induction motor.

10-in. strip mill (1) roughing mill induction motor developing 1,500/1,150/805 h.p. at 325/250/175 r.p.m., with its 750-r.p.m. regulating set, comprising a 310-kW a.c. commutating machine and a 420-h.p. induction motor; (2) the intermediate edging mill, driven by a d.c. variable-speed 230-volt motor developing 50/100 h.p. at 240/600 r.p.m.; and (3) the finishing mill driven by an induction motor developing 2,500 / 2,080 / 1,670 h.p. at 224/200/160 r.p.m., with its 750-r.p.m. regulating set, comprising a 375-kW a.c. commutating machine and a 510-h.p. induction motor.

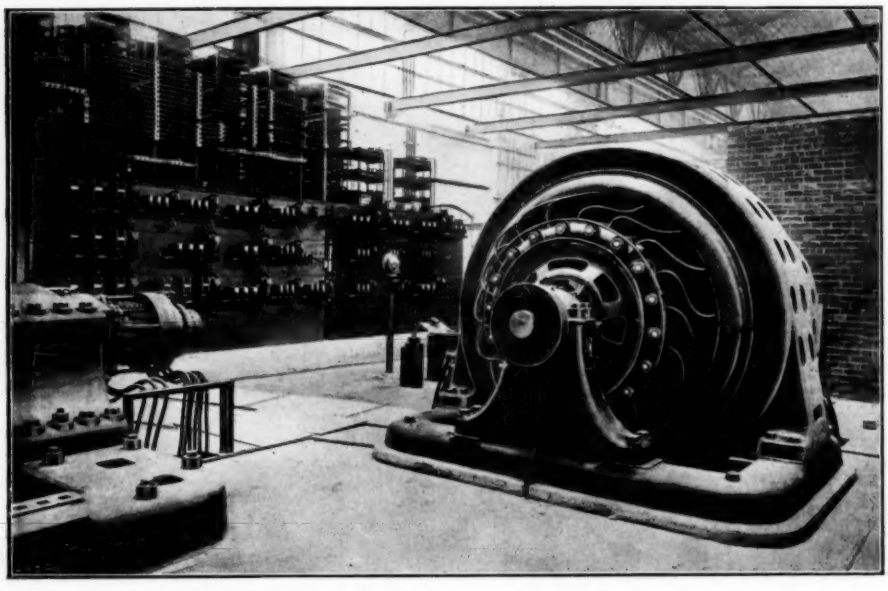


Fig. 3.—Merchant Mill Motor House, Regulating Set and Contactor Gear.

The main mill motors are of the usual three-phase induction type, with polyphase wound rotors, the stator windings being primary and the rotor windings secondary.

If the load remains constant (normal conditions being assumed) and the speed is reduced by the usual method of inserting resistance in the secondary circuit, then, at any definite speed, the voltage and frequency are practically proportional to the slip (stated as a percentage of synchronous speed). If, instead of employing an external resistance, a constant voltage at rotor frequency is used to oppose the secondary voltage, the speed of the rotor will adjust itself to such a value that the secondary voltage will exceed the opposing voltage only by an amount equal to that necessary to send sufficient current through the impedance of the circuits to develop the required torque. If, again, the opposing voltage is adjustable, the speed of the main motor may be changed by the simple operation of varying the value of the opposing voltage.

It is the function of the regulating set to provide a source of adjustable voltage which may be imposed on the secondary windings of the main motor in such a manner as to economically adjust the speed of the latter, independent of the load. The field excitation is obtained from a control transformer provided with a number of taps adjusted by means of a master switch. With this source of excitation, but with power leads open when running at constant speed, the induced voltage of the regulating machine will remain constant, but (in the case of the mill motor) the induced voltage and frequency will vary proportionally with the departure (regulation) from the synchronous speed.

If, under the circumstances described above, the terminals of the regulating motor are connected to the slip-rings of the main motor, any difference between the induced voltages of the two machines will circulate a current through the rotor windings of the main motor and produce, in conjunction with the field of the main motor, a torque therein which, in turn, would tend to adjust the speed of the latter to a value corresponding to that at which the induced voltages of the two machines are equal. The speed of the main motor will vary slightly with the torque, *i.e.*, the greater the torque demanded by the mill, the greater is the departure from synchronous speed (the speed at which the induced voltages of the two machines are equal), this variation in speed being similar to that of a normal induction motor with short-circuited slip rings.

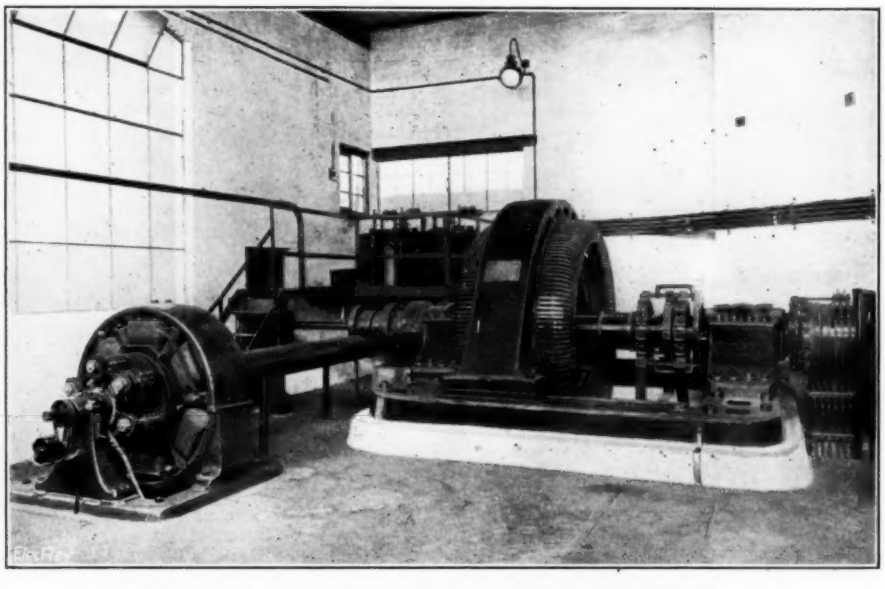


Fig. 4.—Strip Mill Roughing and Intermediate Motors.

The regulating machine consists of a completely compensated, shunt-wound, three-phase, a.c., commutating machine equipped with interpoles and directly coupled to a squirrel-cage induction machine. The function of the squirrel-cage motor is to maintain a practically constant speed for the regulating machine, acting as a motor fed from the line when the mill motor is running above synchronous speed, and as a generator returning energy to the power system when the mill motor is operating below synchronism. When the squirrel-cage machine is motoring, under the conditions described above, the regulating machine is driven as a generator, supplying energy to the slip rings of the mill motor, and when the squirrel-cage machine is acting as a generator, the regulating machine is operating as a motor by power transmitted from the mill motor slip-rings. The regulating machine will operate with either phase rotation at all frequencies up to the maximum and also with direct current.

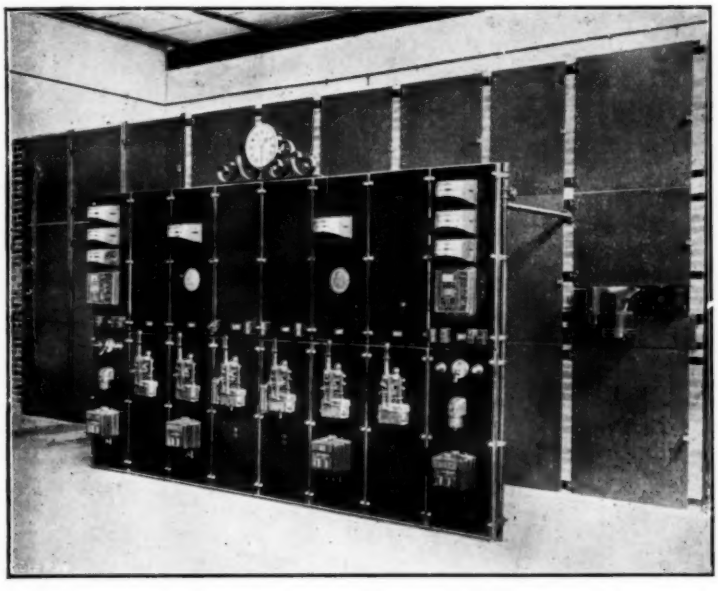


Fig. 5.—Strip Mill Cellular Switchgear.

A second source of excitation, at exact slip-ring frequency and phase rotation at all times, is provided by a commutator frequency-changer called the "ohmic drop" exciter; the latter has the property of giving a constant voltage with a varying frequency, the frequency always being exactly the same as that of the secondary circuit of the mill motor. The armature of this exciter is mounted on the mill motor shaft and resembles the armature of a rotary converter, having both commutator and slip rings. The field punchings which surround the armature are without slots or windings, and the commutator, being usually designed to handle three-phase current, is generally supplied with a multiple of three sets of brushes. The slip rings of the exciter are connected to the main power lines through a transformer so designed that it gives a suitable voltage necessary for exciting the regulating machine.

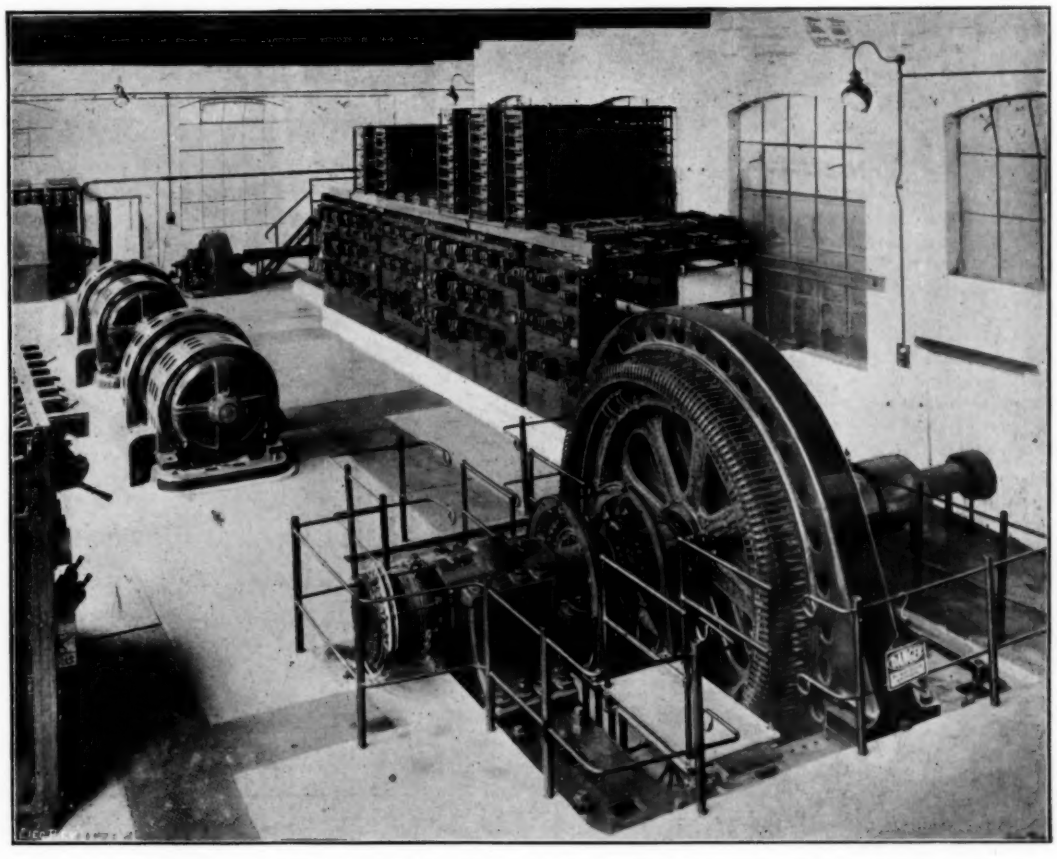


Fig. 6.—Strip Mill; Finishing Mill Main Motor, Contactor Panels, and Regulating Machines.

If, for example, the armature of the exciter is at

rest when voltage is applied to the slip rings, the a.c. in the various coils produces a magnetic field which will revolve round the rotor at a speed depending directly on the frequency and inversely on the number of poles, as in the case of an ordinary induction motor. If, however, the armature of the exciter be rotated at synchronous speed, and if the direction of rotation of the magnetic field be opposite to that of the mechanical rotation of the armature, then the magnetic field will no longer rotate in respect of the stator, but will virtually stand still in space. Under these circumstances the armature conductors, revolving at synchronous speed, would cut this stationary field, and a voltage would be generated which would deliver d.c. from the brushes on the commutator exactly as a d.c. generator would do.

Fig. 7.—Strip Mill.

At one-half synchronous speed the magnetic field would be rotating at half speed in one direction and the armature at half speed in the opposite direction, with the result that the armature conductors would still cut the flux at the same rate as in the previous example and the voltage generated would, therefore, be the same as that at synchronous speed or when the armature was stationary.

The frequency, instead of being zero at synchronous speed, would be one-half of the normal frequency applied to the slip rings of the "ohmic drop" exciter or, in other words, exactly the same as the frequency of the rotor of the mill motor, since the magnetic field of the exciter is rotating in space at one-half of its synchronous speed.

At any other speed, differing from those named above, the voltage generated is similarly constant, and a.c. is delivered from the brushes at a frequency equal to the slip frequency of the mill motor. It should be observed in this connection that a.c. at zero frequency is d.c. If the armature is driven above synchronism, the magnetic field will rotate in an opposite direction, and the machine will deliver a.c., the phase rotation of which will be reversed in comparison with that obtained when operating below synchronism. When operating at any speed other than synchronism a.c. will be supplied to the field windings of the regulating machine and, except at speeds near synchronism, the inductance of the field windings will preponderate over the resistance. As synchronous speed is approached, the excitation supply from the main motor slip rings gradually decreases until at synchronism it becomes zero. It is when near to and at synchronism that the "ohmic drop" exciter is brought into service for excitation purposes, and it should be noticed that at synchronism d.c. will be supplied by this machine. The regulating machine field at such periods will have resistance preponderating over inductance, and the value of the exciting current can be adjusted by altering the amount of resistance in series with the "ohmic drop" exciter.

In addition to the machines described above, the following plant is necessary to complete the electrical equipment for this system:—

Field control exciting transformer.

Interpole transformer for use with regulating set.

H.p. transformer for use with "ohmic drop" exciter.

Transformer for use with regulating set.

Main contactor equipment with resistance for starting the main motor, including the necessary contactors for connecting the regulating machine and "ohmic drop" exciter in circuit when required.

Field control contactor equipment for use with the field control exciting transformer to obtain the various speed points, including the field-reversing contactors, necessary master controllers, interlocking contactors, selector switches, push buttons, &c.

H.p. switchgear with auxiliary transformers.

From the above list it will be realised that the main

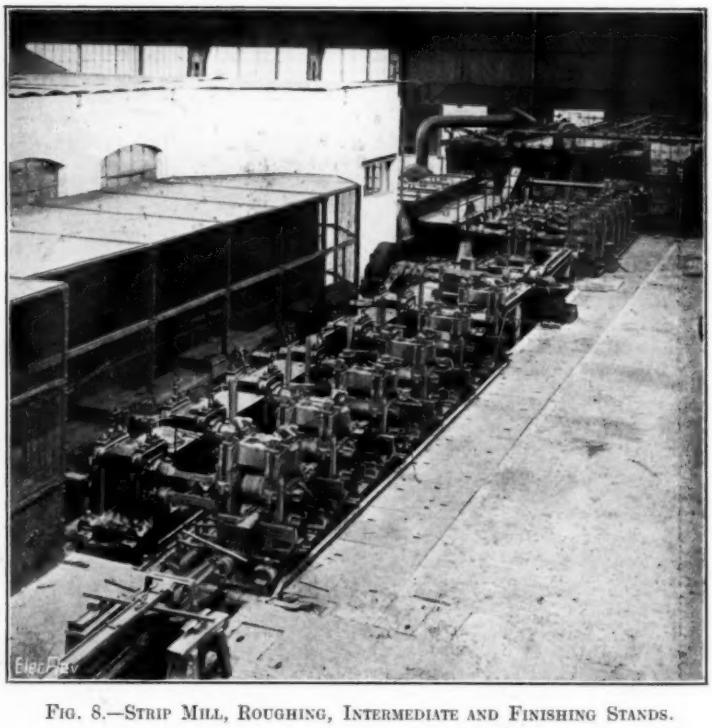


Fig. 8.—Strip Mill, Roughing, Intermediate and Finishing Stands.

circuits are entirely controlled by contactor gear operated by master controllers, and this equipment, which is reversible, in addition to giving the necessary starting points, also provides both a plugging point for use in emergency and speed-regulating points above, at, and below, synchronism. The h.p. switchgear and transformers are housed in brick cells and controlled from a switchboard mounted in front (fig. 5).

The main motors, illustrated in figs. 2 and 6, incorporate means of adjusting the stator, both vertically and horizontally, at right angles to the shaft, of adjusting the air gap, and of moving the stator in a direction at right angles to the shaft so as to facilitate repairs.

The master controllers are arranged so that the operator can control the three roughing, intermediate, and finishing mills from a single pulpit in full view of the loop between the roughing and finishing stands; he can thus control the length of the loop, and is also in a position to shut down the mill quickly in emergency. The panels provided for starting the main induction motors of both the roughing and finishing mills are of the usual type, and consist of contactor switches controlling grid resistances, which are inserted in the rotor circuits of each machine during starting, the closing of the contactors being under the control of current-limiting relays. The operator, if he desires, can start the mill slowly by advancing the master controller one point at a time, but if the controller be thrown hard over, the contactors will only close at a predetermined rate, the amount of current drawn from the line being regulated within definite limits by the relays.

The speed-control panels of the two main motors differ somewhat in arrangement, that for the finishing mill being provided with a manually-operated master controller for giving the required speed changes, whereas the speed of the roughing mill motor is governed by a remote-control master controller, the operator only moving a small pilot switch in the required direction to actuate the motor-driven controller, which is arranged so that it must travel a complete step, even if the operator releases the pilot switch before the controller has had time to complete the full movement to the next notch. Indicating lamps show the direction of movement and whether the controller is raising or lowering the speed, and also whether it has completed its movement to a running notch.

A transfer switch is situated on each of the starting panels to enable the operator to set the control for "regulating" or "non-regulating" running of the main motors; if it is set in the latter position, the last of the series of rotor contactors short circuits the rotor when the machine is up to speed, allowing it to operate as an ordinary induction motor. If, however, the switch is set in the "regulating" position, the main induction motor when up to speed is automatically connected to the armature of the regulating machine, but provision is made that this connection cannot be made unless there is no excitation whatever on the regulating machine.

If the operator desires to run the main motor above synchronism, all that is necessary is to move the regulating controller one point at a time in the desired direction, and, if he wishes to run the motor below synchronism, the same master controller handle is moved in the opposite direction in a similar manner; the contactors on the regulating panel, which are controlled by the master controller, merely change the excitation of the regulating machine to give the voltage variation required to produce the desired speed.

The strip and merchant mills are each entirely controlled by one operator and, although the system of control is somewhat difficult to describe briefly, the actual operation of the mills is extremely simple. The apparatus also is so interlocked electrically that it is quite foolproof, there being no possibility of damage being done even if the wrong sequence of operation is attempted. Emergency push buttons, both on the operator's table and in the mills themselves, enable the main motors to be shut down instantly whenever required.

NOTES.

Sir Alfred Yarrow's Gift for Research.—It is announced that Sir Alfred Yarrow has presented to the Royal Society the sum of £100,000, to be used by the Council for the promotion of research. Writing to the Society, the donor says:—"I have, for many years, held the view that the prosperity of this country has been greatly hampered in the past for the want of better promotion of scientific investigation and its application to practical affairs. I am convinced that the future prosperity of this country will be largely dependent upon the encouragement of original scientific research. The birth of new industries, and the development of existing ones, are due largely to the growth of science, thus securing employment and the welfare of the whole community being advanced. It is doubtful whether even yet it has been realised how completely this country would have been at the mercy of our antagonists in the late war had it not been for the research work done by our scientific men before the war and during its course. I desire to mark my sense of the value of research to the community by offering, as a gift to the Royal Society, £100,000, to be used as capital or income for the purposes of the Society, as the Council may think fit. . . . I should prefer that the money be used to aid scientific workers by adequate payment, and by the supply of apparatus or other facilities, rather than to erect costly buildings.

"In conclusion, I should like to record my firm conviction that a patriotic citizen cannot give money, or leave it at his death, to better advantage than towards the development of science, upon which the industrial success of the country so largely depends."

This is by no means the first of Sir Alfred Yarrow's donations for the public good; but it may well be the most fruitful, if wisely used. *The Times*, in an able article, suggests that the Royal Society, despite its undoubted authority and prestige, has shown a disposition to hold aloof from current affairs and has failed to play its rightful part in the nation's councils; now, says our contemporary, it "has a brilliant opportunity of making good the ground that some of its sincerest well-wishers may have feared that it had lost."

Lectures.—Electricity and Smoke Abatement.—Lecturing before the Bradford Rotary Club, on February 16th (as the guest of the Bradford correspondent of the Electrical Review), Mr. R. J. Steele, B.Sc., M.B.E., president of the Bradford Scientific Association, and an industrial chemist under the Bradford Dyers' Association, Ltd., dealt with the problem of smoke abatement. Mr. Steele urged both factory owners and householders to use electricity, gas, or the products of low-temperature carbonisation—particularly for heating and for industrial power. He strongly urged the abandonment of the coal fire and its replacement by electricity or the other means which provided a smokeless fuel and at the same time helped in the important work of coal conservation. Alderman Dr. D. Walker (deputy chairman of the Bradford Corporation Health Committee), proposing thanks to the lecturer, said it was found in great cities that the death rate, particularly amongst the young and the aged, was very largely related to the amount of smoke in the atmosphere. In his view, general electrification seemed about the most practical line on which they should advance, especially in the household.

On February 22nd., Mr. R. Borlase Matthews, M.I.E.E., was to deliver a lecture on "Making Hay Without Sunshine, and other Applications of Electricity on the Farm," in the Houldsworth Hall, Manchester; the Lord Mayor of Manchester was to preside, supported by Sir Thomas Robinson, M.P., and prominent members of the National Farmers' Union.

Electricity and Medicine.—A new X-ray and electro-medical department has recently been inaugurated at the Dudley Road (Poor Law) Hospital at Birmingham. The radiography room contains the X-ray "camera" and a portable outfit, which takes the X-rays to the bedside of patients too ill to be brought to the X-rays, is provided. The room is lined with lead sheeting to protect persons in adjoining rooms, and the floor is rubber-lined. In the diathermy room there are electro-therapeutic and massage cubicles, with four switchboards arranged for galvanism and faradism.

Heating and Ventilating Workshops.—At a meeting of the Chelmsford Engineering Society, on February 8th, a paper on "The Heating and Ventilation of Engineering Workshops" was read by Mr. Maurice F. Stevens, M.I.H.V.E. The president (Capt. H. Riall Sankey, C.B.) occupied the chair. Mr. Stevens said that the heating and ventilating of workshops had received very scant attention in the past, and that even now it was generally left as the very last thing to be considered when constructing new shops. Nevertheless it was in reality a most important point, since men worked better in properly-heated and ventilated premises. The author described, with slides, several different systems, including gravity and accelerated hot water with one or two pipes, steam systems with one or two pipes, and the "Pleman" system, in which the air was heated and then delivered through pipes to the shops. He said that waste heat from flue gases or from exhaust steam was used wherever possible.

Mid-Lancashire Electricity District.—An inquiry was opened on February 20th, at Preston, with reference to the improvement of the organisation for the supply of electricity in the Mid-Lancashire district. The Commissioners were Sir John Snell, chairman, Sir Harry Haward, and Mr. W. W. Lackie. Two schemes were submitted, one by the Preston and Blackburn Corporations, for whom Mr. Roland Harker appeared, and the other by Burnley, Blackpool, Accrington, Clone, Darwen, Nelson, Bacup, Haslingden, Rawtenstall, Brierfield and Fleetwood, and other localities supporting the East-Lancashire scheme. Mr. Tyldesley Jones, K.C., and the Recorder of Burnley (Mr. T. B. Leigh) represented the East Lancashire authorities, Mr. A. Tylor appeared for the London, Midland & Scottish Railway Co., Mr. Craig Henderson represented the North-East Lancashire Power Co., and Mr. H. W. Cleaver the Lancashire County Council.

For the Preston and Blackburn Corporations, Mr. Roland Harker said there were fundamental differences in the two schemes. At present in a very considerable part of the area there were no facilities at all for electricity supply, and as regarded other parts of the area, although facilities existed, they were very short of what was required and, in fact, did not meet the actual demand.

Counsel proceeded to deal with the objections, and was informed that Bacup had come to an agreement with the East Lancashire promoters. Speaking on behalf of the Corporations which he represented, Mr. Harker said that it mattered not to them whether Clitheroe, Garstang and Pressall were included in the scheme or not. That was a matter for the Commissioners to decide.

Mr. Astley Bell, ex-Mayor of Preston, was the first witness called on behalf of the promoters of the first scheme, and he was still in the box when the inquiry was adjourned until Wednesday. It is anticipated that the inquiry will last several days.

Appointments Vacant.—Lecturer in electrical engineering (Rs. 1,000 per mensem), for the Government of Burma; resident electrical engineer (£350), for the Bo'ness Town Council electricity works; engineering draughtsman (temporary), for the Cardiff Corporation electricity department; chief assistant, station superintendent, mains superintendent, assistant mains superintendent, meter test-room superintendent, charge engineer, for the Halifax Corporation electricity department. (See our advertisement pages to-day.)

The Engineers' Church.—The following letter was received after our "Correspondence" columns had closed: "May I appeal to engineers and managers of manufacturing firms, whose offices are in Westminster, on behalf of Christ Church, Victoria Street, which, owing to its situation, has been well called the Church of the engineers? The present edifice was built in 1843, and is on the site of a chapel where, in 1649, Sir Robert Horley trod the stained glass of the windows under foot and called it 'dancing a jig to Laud.'

"Milton was a parishioner and Dick Turpin lived in a court hard by, so that even before consulting engineers came on the scene great and notorious men lived thereabouts. During the last 25 years the neighbourhood has changed from a residential to a business centre, and the Rev. P. T. R. Kirk, the present vicar, is following the practice of churches similarly situated, by holding regular week-day services, at some of which addresses are given by prominent laymen.

"The interior of the church has not been renovated for very many years, and it is especially in need of electric light to replace the present awful gas lamps, which disgrace a district where there are more electrical engineers to the square mile than anywhere else in the world. Also alas! the heating apparatus is a coal eater and a smoke maker, both of which evils big engineer firms in Victoria Street know well how to cure.

"Subscriptions are asked for the renovating fund, but as they are difficult to obtain in these days it is suggested that firms interested in electric lighting and heating might subscribe in kind, for example, cables, fittings, lamps, heating boiler, piping, &c. It is estimated that the electric lighting will cost £300. By making a first-class job engineers will be able to show clients how a church should be lighted and heated.

"As a member of the engineering profession I make a very earnest plea for this historic church. I think it is up to the engineers of Westminster to make it worthy of the rich city in which they do business."

E. Kilburn Scott.

London, *February* 19th, 1923.

Non-Ferrous Metals Research.—The British Non-Ferrous Metals Research Association is communicating the results of its investigations to its members by means of lectures, to which, as a rule, only the members of the Association itself are admitted. Thus early confidential communication of results is assured to those who have given financial support, and the investigator gets into close and immediate contact with that section of the industry chiefly interested in his work. So far the private lecture system has been applied to two subjects. Dr. W. Rosenhain, F.R.S., has reported on the investigation on copper and the influence upon its properties of small quantities of impurities, which is being carried out for the Association by Dr. D. Hanson and others at the National Physical Laboratory; this research promises to be of fundamental importance to the copper and brass industry, and most of the leading firms are supporting the work. A large attendance of members was occasioned by a lecture on "The cause and prevention of Red Stains on Brass," by Mr. E. A. Bolton, M.Sc., describing work on this troublesome difficulty, which he is carrying out at the Birmingham University—another subject of great practical interest. The Association has now arranged for a third lecture to be given, both in Birmingham and in Sheffield, by Mr. Dartrey Lewis, M.Met., on his work on "Materials used for the Abrasion and Polishing of Metals." In view of the wide interests covered a limited number of tickets is being issued to non-members. The Birmingham lecture will be held on February 26th, at 7.30 p.m., and the Sheffield lecture to-day at 2.30 p.m. Tickets, so far as space permits, can be obtained on written application by firms to the Association's offices, 71, Temple Row, Birmingham.

The Placing of Contracts by Public Bodies.—Whilst going to press we learn from Mr. C. W. Crosbie that an error occurred in his letter which appeared in our last issue; although the copper losses were stated to have been taken at 20 per cent. load factor, the figures as they stand represent the losses at 100 per cent. load factor. Mr. Crosbie expresses much regret for the error; the corrected figures show a difference in the present values of £542 instead of £1,002. Even this sum, he says, "would appear to be too high a price for the ratepayers to bear for the privilege of providing £85 in wages to be paid and expended in another part of the country."

A letter on this subject appears on p. 290 of this issue.

The British Electrical Development Association, Inc.—The annual general meeting will be held at the Hotel Cecil, on March 16th, at 12 noon. It will be followed by the annual luncheon. The price of the tickets is 12s. 6d., and they are obtainable from the Association's offices, 15, Savoy Street, W.C.2.

Dinner.—The annual dinner and musical evening of the National Association of Supervising Electricians was held at the Holborn Restaurant on February 17th, when a large company of members and guests enjoyed a most successful function. Many important firms in the electrical industry were represented, whilst Mr. W. E. Highfield, M.I.E.E., president of the N.A.S.E., occupied the chair, and he was supported by Mr. F. Gill, president, I.E.E., Mr. W. Lang, representing Sir T. Callender, Mr. J. S. Highfield, M.I.E.E., Sir Burton Chadwick, M.P., and Mr. W. C. Keay, general secretary of the National Federation of Professional Workers. An excellent musical programme, under the direction of Mr. George Robinson, was greatly appreciated.

Following the loyal toast, Sir Burton Chadwick, M.P., proposed the toast of "The President," which was accorded musical honours, and paid high tributes to the services and experience of Mr. W. E. Highfield in the electrical industry. Mr. W. E. Highfield expressed his appreciation of the reception they had accorded him and said the future prospects of the Association were excellent.

Mr. F. Gill, in proposing the toast of "The Association," referred to the respect the N.A.S.E. had won in the industry. It was one of the trade unions that thought beyond to-day. This was indicated by its educational scheme, which he considered of enormous importance. A broader education than mere technical training was necessary, and administration, economics and psychology must be covered. The electrical industry was going to be the biggest in the world, but one of the penalties of progress was change, and any one who did not keep his mind flexible and receptive to new ideas, and keep up with new methods, generally was bound to be left behind.

Mr. T. H. Windibank, replying to the toast, said that their members' conception of trade unionism was of a much higher order than that commonly held by the "man in the street." The Association was a trade union of "black-coated workers" who were not out for what they could get, but had the good of the industry at heart. To that fact could be attributed the continued and steady growth of the Association, which was never in a more flourishing condition. One of the main planks of the Association's policy was education. *Contact*, their official organ, had been revised during the year, and deserved the wholehearted support of the members. The Association had a national agreement with the N.F.E.A., and during the past two years practically no revision of wages had been necessary. Mr. Windibank also referred to the appointment of district representatives and the formation of a new Centre at Manchester. Conciliation and arbitration were what they had faith in, and the progress of the Association proved they were right.

The toast of the "Visitors" was proposed by Mr. J. S. Highfield in an admirable speech, in which he complimented the Association on its splendid achievements. Mr. W. E. Warrilow replied with a humorous speech, and the toast of "The Press" was proposed by Mr. R. W. Whitley, to which Mr. S. Rentell, Editor of *Electricity*, suitably replied.

E.D.A. Salesmanship Conference.—At the 11th sales conference of the present session, to be held at Caxton Hall on March 2nd, a paper will be read by Mr. A. Gowans Whyte, on "The Industry, The Press, and The Public." Mr. C. H. Wordingham, C.B.E., will occupy the chair.

Caution to Inventors.—The Chartered Institute of Patent Agents asks us to advise inventors to beware of suggestions such as are now being issued from a German source to the effect that, for reasons obscurely stated by the German writer, the British inventor should co-operate with him, and in particular should send him by registered letter a sum of money. The communication is alleged to be fraudulent, and on no account should money be sent.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Faraday Medal.—At the meeting of the Institution on the 15th inst. the president announced that the Faraday Medal, the highest honour which the Institution is able to bestow, had been conferred upon Sir Charles A. Parsons, K.C.B., F.R.S., and that the presentation would take place on May 10th. Sir Charles was present, and briefly expressed his appreciation of the Council's action.

Informal Dinner.—It has been arranged for members to dine together informally at the Engineers' Club after the meeting on March 1st. Those intending to dine should notify the secretary as early as possible; it must be pointed out that the attendance at these dinners has recently been very small, and if the members desire that they should be continued, better support must be given.

Smoking Concert.—The annual smoking concert of the Informal Meetings Section will be held at the Engineers' Club, London, on Monday, February 26th, at 7.45 p.m. The privileges of membership of the Club will be extended to visitors for the evening. Mr. W. E. Warrilow will occupy the chair, and the committee hopes there will be a good attendance. Those who have not already obtained tickets can purchase them at the Club on the evening of the concert.

Sheffield Students' Section.—A meeting of this section was held in the University of Sheffield on the 14th inst., when Mr. H. Taylor (chairman of the Section) read a paper on "Electromagnets." The paper dealt chiefly with electromagnetism as commercially applied to lifting magnets, and covered their construction, application, performance, and design. It was illustrated by lantern slides, and an interesting discussion followed.

Mersey and North Wales (Liverpool) Centre.—At a specially convened meeting held at the University, Liverpool, on February 19th, the following were elected as officers and committee for the new Centre:—*Chairman*, Mr. B. Welbourn; *Vice-Chairmen*, Messrs. Hollingsworth and Harrison; *Committee*, Messrs. Breach, Clothier, Eames, Hamilton, Hawkins, Lang, Malpas, Morton, Moxon, Priestly, Robinson, Teago, Dickinson and Nisbett, and Prof. E. W. Marchant; *Hon. Secretary*, Mr. O. C. Waygood.

The Lord Mayor of Liverpool was present and addressed the meeting, and Mr. P. J. Robinson read his paper on the automatic sub-station erected at Walton, Liverpool.

A discussion followed, the following taking part:—Messrs. Peck, Williams, Povey, Waygood, Breach, Harrison, Adam, Turner, and Collie.

Scottish Centre.—*Annual Dinner.*—The annual dinner of the Scottish Section of the Institution will take place at the Central Station Hotel, Glasgow, on March 5th. Mr. Frank Gill, the president, Mr. J. S. Highfield, immediate past president, and Mr. P. F. Rowell, the secretary, will be present, and the Corporation and important local industries will be represented.

A.M.I.E.E. Examination.—It is proposed to hold the Associate Membership examination in London and other places (at home and abroad) towards the end of April. Entry forms and full particulars can be obtained from the secretary of the Institution, Savoy Place, Victoria Embankment, W.C.2.

Institution of Mechanical Engineers.—The report of the Council for the year 1922 records an increase of membership in all classes from 7,994 to 8,734. Mention is made of honours bestowed upon members, and the decease of 70 members is recorded, including Dr. Edward Hopkinson, a past president. The progress of research committees on alloys, cutting tools, hardness tests, steam nozzles, &c., is reported, and a great deal of other information is given. The accounts show an income of £28,655, and an expenditure of £28,738—an adverse balance of £83. A very sound financial position is indicated by the balance-sheet.

Royal Institution.—On Thursday, March 1st, at 3 o'clock, Mr. Theodore Stevens is to deliver the first of two lectures at the Royal Institution on "Water Power of the Empire."

Incorporated Municipal Electrical Association. — The annual convention is to be held at Scarborough, from June 18th to 22nd.

Röntgen Society.—At a joint meeting with the Physical Society of London, at the Imperial College of Science this evening, there will be numerous demonstrations of methods of measuring X-rays. Among those participating are: Sir William Bragg, F.R.S., Dr. G. W. C. Kaye, Dr. E. A. Owen, Major C. E. S. Phillips, and Dr. F. L. Hopwood.

The sixth Silvanus Thompson Memorial Lecture will be delivered by Dr. C. Thurston Holland on May 1st next.

Diesel Engine Users' Association.—At the next meeting of the Association on March 2nd the subject of "Heavy Oil Engine Working Costs" is to be considered and discussed. The Association has collected data of the actual working costs of a large number of Diesel and semi-Diesel engine installations during the last few years, and the committee will be making a report to serve as a basis for a discussion of the whole subject and will invite general suggestions from the members as to the most useful purpose to which the information already collected can be put, as well as any further figures which it is proposed to collect from year to year. Non-members interested in the subject and desirous of attending the meeting can apply for tickets of admission to the hon. sec. of the Association at 19, Cadogan Gardens, S.W.3.

Faraday House Old Students' Association.—Annual Smoking Concert.—The annual smoking concert of the Association will be held at the Hotel Cecil on March 22nd, and the Concert Committee appeals to all members to assist in making the evening a success by bringing as many guests as possible—Faradians or others. An excellent musical programme is being arranged.

Sports Club.—The members of the Faraday House Sports Club are anxious to meet old Faradians, and therefore ask them to join members of the Club at dinner on that evening at the Hotel Cecil.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Mr. R. W. Belcher, late manager of the London branch of the Concordia Electric Wire Co., has now joined the Scott Insulated Wire Co., Ltd., as commercial representative, at its head office and works, Park Works, Campbell Road, Finsbury Park, N.4, where all communications should be addressed.

Captain John Arthur Spencer, A.M.I.M.E., has been appointed general manager of the business of Messrs. A. C. Alexandra & Co., of Westminster.

We regret to learn that Mr. A. S. Hughes has resigned the position of chief electrical engineer to the Burgh of Falkirk owing to a breakdown in health. The Town Council has unanimously decided to appoint Mr. Thomas M. Climie, who has been assistant engineer and deputy chief for the past three years, to the position of chief engineer.

Mr. H. I. Lewenz, who has returned from China after a three years' stay, will be glad to hear from friends. His address is c/o Vickers, Ltd., Vickers House, Broadway, London, S.W.1.

Sir Thomas Baker, late chairman of the Corporation Tramways Committee at Plymouth, has been presented by the employés with an illuminated address, bearing photographs of the tramways undertaking, as a token of esteem.

Mr. J. W. Shaw, chief telegraphist at the Central Railway Station, Leeds, of the London & North-Eastern Railway, has retired from service after 50 years with the company.

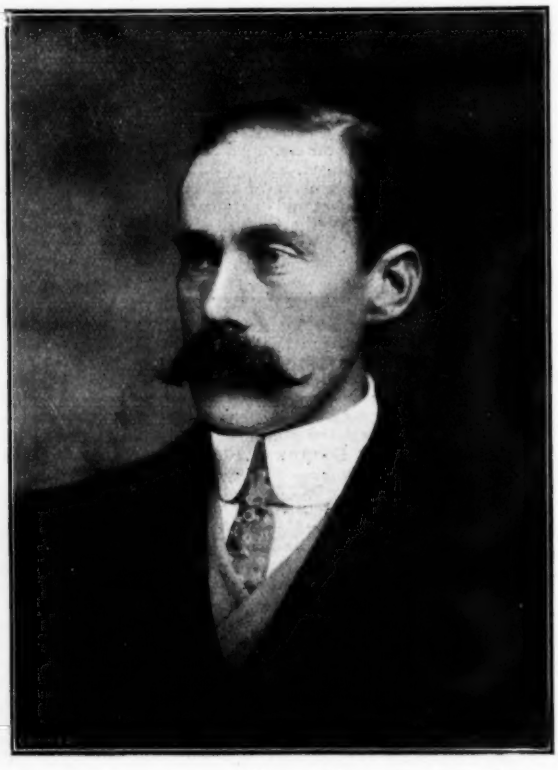
Mr. John Conway has been appointed lecturer on electrical engineering at the Dundee Technical College in succession to Mr. Robert D. Archibald, who has accepted an appointment at the Royal Naval College, Plymouth. Mr. Conway is a B.Sc. of Glasgow University and is at present lecturer on electrical engineering at the Technical College, Portsmouth.

The Dumfries Town Council has appointed Mr. W. S. Johnston (engineer in charge of the electricity works at the Gretna munition factory) to be manager of the electricity undertaking which it has taken over. The salary is £450, with free house. There were 93 candidates for the post.

Recently the Carlisle Town Council decided to reduce the salaries of officials who are in receipt of upwards of £500 per annum. These officials, including the electrical engineer, have sent to the Corporation a memorandum agreeing to a reduction of 5 per cent. in their salaries as from March 1st next. The Council has been recommended by a committee to accept this offer and to rescind the previous resolution to reduce the salaries by 10 per cent.

Manchester Electricity Committee has appointed Mr. J. A. Vice, turbine house superintendent, assistant resident engineer, Stuart Street Station, at a salary of approximately £618 per annum.

Obituary.—MR. T. W. STRATFORD-ANDREWS.—We regret to record the death of Mr. Thomas William Stratford-Andrews, managing director of the Indo-European Telegraph Co., Ltd. He passed away in London on Saturday last. He was born in London in 1870, and was the son of Mr. William Stratford-Andrews, who was managing director of the same company until 1899. It was in that year that the son succeeded his father, to whom he had been acting as assistant for three years, that is from 1896, shortly after he returned from Berlin, where he had been completing his technical training at the Siemens-Schuckert works. Prior to going to Berlin he was at King's College, London, studying electrical engineering. Between his residence in Berlin and his actual taking up of duties with the Indo-European Co. in London, he joined the expedition which went 800 miles up the River Amazon to lay a telegraph cable in extension of the Western and Brazilian system. He had not been a year in the London offices when it fell to him to set out on a tour of inspection of the company's land lines in Russia and Persia as far as Teheran. He



Elliott & Fry] [*London.*

THE LATE MR. T. W. STRATFORD-ANDREWS.

rode on horseback through Russia and across the Caucasus. This interesting journey he subsequently described in a small book entitled "Overland to Persia." We read in *The Times* that he covered the same ground by motor-car in the year 1913. While he was in Teheran experiments were conducted, as the outcome of which direct Wheatstone working over the Indo-European lines between London and Teheran was introduced, and with such success that the system was extended later to Karachi over the lines of the India Office Telegraph Department. The deceased gentleman was a director of the Western and Brazilian Telegraph Co., the London-Platino Brazilian Telegraph Co., Galletti's Wireless Telegraph and Telephone Co., and the Delhi Electric Tramways and Lighting Co., and he was chairman of the Radio Communication Co. Mr. Stratford-Andrews was decorated by the Shah of Persia and thanked by the Russian Government of those days for his services.

MR. W. FARROW.—The death occurred suddenly on February 5th of Mr. Walter Farrow, head of the firm of Farrow and Sons, electrical engineers, of New Street, Chelmsford. He was 67 years of age, and succeeded to the business of his father, the late Mr. Henry Farrow, with whom he served his apprenticeship. For some years he had served on the Town Council.

MR. F. S. THOMAS.—The death took place suddenly on February 8th of Mr. Francis Sales Thomas, chairman of the Saxonia Electrical Wire Co., Ltd., of Greenwich. He established the business of the company in 1895.

MR. H. TROWBRIDGE.—In the death of Mr. Henry Trowbridge, which occurred at his home at East Ham, on 19th inst., after a somewhat lengthy illness, the India Rubber, Gutta Percha & Telegraph Works Co., Ltd., has lost another old member of their staff at Silvertown. Mr. Trowbridge, who was born in 1863, was, during his 43 years' service with the company, connected chiefly with the electrical side of the firm's activities.

Will.—The late Mr. J. M. HENDERSON, a director of various companies, including Ferranti, Ltd., the Lancashire United Tramways, and Thomas Bolton & Sons, Ltd., left £110,339 gross and £96,937 net personalty.

NEW COMPANIES REGISTERED.

Automatic Burglar Alarm Co., Ltd. (187,723).—Private company. Registered February 10th. Capital, £1,000 in £1 shares. To take over the business of an electrical, constructional, and burglars' fire alarm engineer, contractor and dealer in machinery carried on by G. B. Carpenter at 7, Finsbury Square, E.C. The permanent directors are: G. B. Carpenter, 275, Golders Green Road, N.W.11, electrical engineer; H. N. Gunn, 48, Ashbourne Avenue, N.W.1, accountant. Registered office: 7, Finsbury Square, E.C.

Bloom's (Wireless), Ltd. (187,762).—Private company. Registered February 13th. Capital, £100 in £1 shares. To carry on the business of radiographic, telegraphic, telephonic, electrical and general engineers, suppliers and distributors of electricity and electrical energy, manufacturers of and dealers in all apparatus and appliances, including installations for wireless or any method of communication, &c. The subscribers (each with one share) are: W. A. Zabell, 11, Queen Victoria Street, E.C.4, solicitor; A. E. Webster, 40, Mayfield Road, Plaistow, Essex, accountant. The first directors are not named. Solicitors: W. A. Zabell, 11, Queen Victoria Street, E.C.4.

British Illuminated Sign Co. (1923), Ltd. (187,763).—Private company. Registered February 13th. Capital, £2,000 in £1 shares. To acquire the business and assets of the British Illuminated Sign Co., Ltd., and to acquire and develop patents, trade marks, and secret processes in the United Kingdom and elsewhere of inventions for improvements in motion illuminated advertising devices. The life directors are: E. C. Leachman, Strathcona, Flackwell Heath, Bucks; A. H. Bikker, 5, Marine Parade, Seaford, Sussex; R. G. Bradshaw, 47, Christchurch Road, S.W. Qualification: 500 shares. Remuneration: 10 per cent. of the net profits divided between them. Secretary: E. W. Marchington. Registered office: 1, Bosworth Road, W.10.

Dolywern and District Electricity Supply Co., Ltd. (187,790).—Private company. Registered February 14th. Capital, £1,000 in £1 shares. To carry on the business indicated by the title. The first directors are: C. Edmunds, Ceiriog, Dolywern; E. Evans, Gwern-y-Glyn, Dolywern; A. R. Gamble, 283, Belgrave Gate, Leicester. Secretary: E. Evans. Registered office: Gwern-y-Glyn, Dolywern, Denbigh.

Forum & Co., Ltd. (187,794).—Private company. Registered February 14th. Capital, £5,000 in £1 shares. To carry on the business of manufacturers, and assemblers of, concessionaires for and dealers in scientific instruments, electrical accessories, mechanical, illuminating, advertising, telephonic, telegraphic, aerial, wireless and other apparatus, &c. The subscribers (each with 20 shares) are: J. A. Porter, Carlton House, 48, Bank Street, Coseley, Staffs., motor electrician; Mary J. Porter, Carlton House, 48, Bank Street, Coseley, Staffs., costumier. J. A. Porter is permanent governing director and chairman, subject to holding 500 shares. Registered office: Sydenham Buildings, 7 and 9, Pershore Street, Birmingham.

Rheostatic Co., Ltd. (187,907).—Private company. Registered February 14th. Capital, £12,000 in £1 shares. To acquire the business of electrical engineers carried on by L. Satchwell and D. H. John at Slough, Bucks., as the "Rheostatic Co.," and the inventions, letters patent and patent rights of the said L. Satchwell, and to carry on the business of sheet metal workers, electricians, electrical and mechanical engineers, suppliers of electricity, &c. The first directors are: L. Satchwell, "The Cot, Windsor Road, Slough; D. H. John, Farnham Road, Slough; F. C. Anderson, 196, Greengate, Manchester; C. A. Atchley, 196, Greengate, Manchester; F. G. Warburton, 196, Greengate, Manchester; A. H. Foyster, 3-4, Lincoln's Inn Fields, W.C. The Harland Engineering Co., Ltd., may, so long as it holds 50 per cent. of the issued share capital, appoint and remove three directors. The said F. C. Anderson, C. A. Atchley, and F. G. Warburton are the first nominees. The said L. Satchwell, D. H. John and A. H. Foyster shall be permanent subject to holding 500 shares each. Qualification (except "Harland" directors): 100 shares. Registered office: Buckingham Avenue, Trading Estate, Slough.

Premier Electrical Supplies, Ltd. (187,531).—Private company. Registered February 2nd. Capital, £1,000 in £1 shares (500 10 per cent. cumulative preference). To carry on the business of manufacturers, importers, and exporters of, and dealers in electric, magnetic, galvanic, and other appliances, electrical engineers and contractors, &c. The first directors are:—A. H. Tappy, 53, Warwick Gardens, Harringay, N.4, electrical engineer; R. A. B. Hill, 124, Seymour Road, Hornsey, N.8, electrical engineer (both permanent, subject to holding 50 shares each). Registered office: 3, New Oxford Street, W.C.1.

Electric Welders (Leeds), Ltd. (187,517).—Private company. Registered February 2nd. Capital, £1,000 in £1 shares. To carry on the business of oxy-acetylene, arc, butt, spot, ferrous, non-ferrous, copper, and aluminium welders, engineers, &c. The subscribers (each with one share) are:—P. M. Wilson, 17, East Parade, Leeds, chartered accountant; G. H. Walker, Standard Buildings, City Square, Leeds, engineer; E. S. Semper, Standard Buildings, City Square, Leeds, engineer. P. M. Wilson signs as director. Remuneration as fixed by the company. Registered office: 42, Hunslet New Road, Leeds.

Radiax, Ltd. (187,701).—Private company. Registered February 9th. Capital, £500 in £1 shares. To carry on the business of electrical, general and motor engineers, manufacturers of and dealers in wireless and radio apparatus and components, electrical plant and machinery, &c. The first directors are: A. E. Oakley, Warescot, Warley Road, Brentwood, Essex; E. H. Ruscoe, The Chestnuts, Headstone Drive, Harrow, Middlesex. Secretary: H. Stokes. Registered office: 4, Percy Street, Tottenham Court Road, W.1.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

East Anglian Electricity, Ltd.—Satisfaction to the extent of £1,000 on February 1st, 1923, of debenture dated November 30th, 1922, securing £3,000.

Star Lamp Co., Ltd.—Particulars filed of £1,500 debentures authorised February 7th, 1923, charged on the company's undertaking and property, including uncalled capital, the whole amount being now issued.

Palmer, Riley & Co., Ltd.—Deed of covenant and conditional surrender, dated January 29th, 1923, to secure £900, charged on certain property in Accrington. Holder: O. Clegg, 93, Dowry Street, Accrington.

CITY NOTES.

Westminster Electric Supply Corporation, Ltd.

The report for 1922 reports an increase of connections from 59,132 kW to 61,805 kW. The balance of net revenue, after providing for depreciation, sinking and reserve fund and other charges, is £132,541. After meeting the preference dividend and paying in all 12 per cent. for the year on the ordinary shares, £17,116 remains to be carried forward. Acting upon powers given at meetings held in July last, suitable provision has been made for Captain Bax, the managing director, on his retirement. He has been in the service of the Corporation since its inception (first as general manager, then as director, and since 1914 as managing director). Last August the board granted him £7,000 instead of a pension, and this sum is charged against revenue in the present accounts. The number of directors was increased to eight and Sir Alex. Kennedy, who has been engineer-in-chief of the company since its inception, has accepted an invitation to fill the above vacancy, and he will also continue his duties as engineer-in-chief. Mr. W. A. Pearman, who has been with the company almost from its commencement, has been appointed general manager in addition to being secretary. The report contains brief reference to the unsatisfactory proposals of the Electricity Commissioners as regards London, and to the Bill which the company has promoted in conjunction with others for the consideration of Parliament. The vacancy on the board due to the death of Mr. Montague Gluckstein has been filled by the election of the Rt. Hon. Gerald W. Balfour. Units generated, 39,754,787; units sold, 30,261,324. Meeting, February 28th.

Northampton Electric Light and Power Co., Ltd.

Mr. F. H. Thornton, presiding at the annual meeting last week, said that the working expenses had decreased by 33 per cent., chiefly due to the economy of working at the Hardingstone station and to the lower cost of coal, thus enabling substantial reductions to be made in charges to consumers. The new 6,000-kW set would be running in the course of the next few days, and it was bound to help materially in reducing costs. The Order made by the Electricity Commissioners had been confirmed by the Minister of Transport. Tenders had been invited for cables, switchgear, and transforming plant necessary for carrying out the scheme, and it was hoped that by the close of the year both Wellingborough and Rushden would be receiving bulk supplies from the company. In order to encourage the increased use of motors, which they believed to be of vital importance to the trade of the town, they proposed to reduce the rents of hired motors by a further 15 per cent. as from July 1st next. In a speech delivered later one of the directors said that there was a greater demand for new installations than had ever been known in the history of the company, the demand being chiefly concerned with middle-class house property.

Kensington and Knightsbridge Electric Lighting Co., Ltd.

The report for 1922 states that the connections increased from 20,162 kW to 21,159 kW, and 7,506,015 kWh was supplied to consumers. Net profit £26,199, plus £4,014 brought forward. After paying the first and second preference dividends and 12 per cent. for the year on the ordinary shares, £12,114 is to be carried forward. The balance of the renewal and reserve fund account now stands at £182,293. The report briefly refers to the unsatisfactory proposals of the Electricity Commissioners and to the Bill promoted by the companies, in which the Kensington and Knightsbridge Co. is interested. The directors place on record their appreciation of the services rendered by the late Mr. H. W. Miller, managing director.

Metropolitan Railway Co.

The total net income for the year ended December 31st, 1922, was £840,048, as compared with £750,946, and £17,797 was brought forward from the last account, making a total of £857,845. From this have been deducted £307,842 for interest, rentals, other fixed charges, and appropriation to general reserve, and £256,457 dividends on preference stocks, leaving a balance of £293,546. After paying a total dividend on the ordinary stock of £3 10s. per cent. for the year, the sum of £33,137 remains to be carried forward. The previous year's dividends amount to £2 5s. per cent. The dividend on the Surplus Lands Stock was raised from £3 to £3 2s. 6d. per cent.

Considerable additions are being made to the station accommodation at Wembley Park in anticipation of next year's Empire Exhibition. The contract for the authorised extension to Watford has been let, and the work has been commenced. Contracts have also been awarded for improvements at Farringdon Street, Moorgate Street, and Baker Street stations.

Underground Electric Railway Companies.

Below we give more extended details of the companies' reports than we were able to give in our last issue:—

Central London Railway Co.—The total net income amounted to £271,692, an increase of £10,570; this with a balance of £59,644 brought forward made an available total of £331,336. The following deductions were made: Interest, rentals, and other fixed charges, £46,325; appropriation to reserve, £69,000; and dividend on preference stock, £21,600. The balance was thus £194,411, and after the payment of final dividends, £74,411 remained to be carried forward.

Metropolitan District Railway Co.—The total net income increased by £62,665 to £725,219, and with £60,550 brought forward, a total of £785,769 was available. Out of this were paid: Interest, rentals, and other fixed charges, £328,214; appropriation to reserve, £85,000; and dividend on guaranteed and preference stocks, £198,430. From the balance of £174,125, final dividends took £97,050, leaving £77,075 to be carried forward.

London Electric Railway Co.—The total net income showed an increase of £170,625 to £978,668, and with £39,744 brought forward, a total of £1,018,412 was available. From this were deducted: Interest, rentals, and other fixed charges, £299,505; appropriations to reserve, £90,000 and £55,000; and dividend on preference stock, £126,947; leaving a balance of £446,960. After the payment of final dividends, a balance of £73,842 remained to be carried forward.

City & South London Railway Co.—An increase of £44,960 in the total net income brought it to £224,827, and to this was added £25,276 from the previous account, making £250,103. Against this were charged: Interest, rentals, and other fixed charges, £47,039; appropriations to reserves, £46,000 and £27,500; and dividend on preference stock, £42,500; leaving a balance of £87,064. The carry-forward, after the payment of final dividends, was £27,864.

The summary of results from the working of the above companies, which, together with the London General Omnibus Co., constitute the "Underground" group, gives the following figures for the year ended December 31st, 1922:—

	1922.	Increase + Decrease −
	£	£
Traffic receipts	12,278,326	−220,315
Expenditure	9,943,028	−482,901
Net receipts	2,335,298	+262,586
Miscellaneous receipts (net)	641,578	+ 54,662
Total net income	2,976,876	+317,248
Deduct—		
Interest, rentals and fixed charges	865,104	− 2,525
Appropriation to reserve for contingencies and renewals	665,000	+135,000
Appropriation for equalising the charge in respect of interest on the 4½ per cent. redeemable second debenture stocks	82,500	+ 822,500
Dividends on guaranteed and preference stocks	389,477	—
Total deductions	2,002,081	+214,975
Balance	*974,795	+102,273
Add balances from last year's accounts	253,142	+117,431
Total amount available for dividends on ordinary stocks and shares and for other purposes	1,227,937	+219,704
Amount paid in dividends on ordinary stocks and shares representing an average rate of 4.69 per cent. in 1922 and 3.92 per cent. in 1921	902,983	+147,892
Balances carried forward to next year's accounts	324,954	+ 71,812

The traffic statistics show a net increase, although workmen's and season tickets showed a decline. The figures are as follows:—

Passengers carried.	1922.	Inc. or dec.
Ordinary	1,066,656,847	+76,150,971
Workmen	50,705,469	− 2,107,177
Season	54,565,450	− 1,993,950
Total	1,171,927,766	+72,049,844
Number of car-miles run	163,401,602	+ 7,555,618

The annual meetings of the companies were held yesterday (Thursday).

* After the operation of the Common Fund reserves were increased by £55,000, which explains the difference between the balance of £974,795 shown above, and the amount of the Common Fund, which is given as £1,029,795, as against £909,272.

South Metropolitan Electric Light and Power Co., Ltd.

The report for 1922 shows a revenue credit balance of £142,724, plus £21,498 brought forward, and £1,001, the dividend of 10 per cent. on the company's holding in the West Kent Electric Co., Ltd., for 1921. Debenture and other interest charges having been met, and the preference dividends paid, £25,000 is put to depreciation, £55,000 to credit of reserve, 10 per cent. (less tax) is recommended on the ordinary shares, and £10,000 is put to reserve for an employés' benefit fund, leaving £28,843 to be carried forward. There was a material increase in energy sold and the net revenue showed a very satisfactory improvement. The West Kent Co. recommends a dividend of 10 per cent., as in the previous year, placing £8,000 to reserve. 10,166 preference shares were issued during the year. Meeting, February 28th.

Fuller's United Electric Works, Ltd., and Reduced.

The company has issued a circular to the preference shareholders and note-holders in respect of an issue of 6 per cent. first mortgage debenture stock (£80,000), which is offered to them at par. It will be remembered that the scheme of reconstruction has been approved by the Court and steps are now being taken to carry it into effect. Mr. F. R. Wade has accepted the chairmanship of the company in place of Mr. G. Fuller, M.I.E.E., who has retired, and Messrs. C. H. Wayte (a member of the Stock Exchange), and Mr. W. L. Topple, M.I.Mech.E., &c., have joined the board as financial director and works director respectively. Drastic schemes for concentration and economy are under consideration, together with a carefully-considered plan for sales expansion, and it is believed that these and other changes will ensure the successful future trading of the company. It is gratifying to note that the company's operations for the last six months show a great improvement, and everyone will wish success to a business which has been in existence for over half a century. Orders are increasing and there is every prospect of an improvement in the electrical trade.

London Electric Supply Corporation, Ltd.

The report for 1922 shows a profit of £150,199, against £102,286 for 1921. Adding £14,081 brought forward, less loan interest £1,302, makes the total £162,978. Debenture interest, £23,494; sinking fund for debenture stock redemption in 1931, £16,580; 6 per cent. preference dividend, £26,952; 10 per cent. on the ordinary shares, £33,300; reserve, £15,000; depreciation, £20,000; contingencies, £5,000; carried forward, £22,652. Sinking fund for the redemption of debenture stock in 1931 now amounts to £193,924, and £68,224 invested in accordance with agreements with the Westminster and St. James' Companies. The energy sold amounted to 49,675,886 kWh, as against 47,490,802 kWh for 1921, an increase of approximately 4½ per cent., whereas, owing to the reduction in charges for lighting and power, the gross receipts have fallen from £393,674 to £374,092. The average receipt per kWh sold was 1.74d., as compared with 1.91d. Further reductions in charges to the public came into operation on January 1st, 1923. The report contains references to the proposals of the Electricity Commissioners and to the Bill of the associated companies. Meeting: February 23rd (to-day).

Paisley District Tramways Co.

The revenue for 1922 was £138,489 and the expenditure £105,954. After meeting debenture and other interest, sinking fund charges, income tax, and Parliamentary expenses, £22,558 remains, plus £8,033 brought forward. There is put to general reserve £6,000; 5 per cent. dividend is paid on the preference shares; £2,000 is put to preference share sinking fund; 4 per cent. dividend is to be paid on the ordinary shares, and £8,610 carried forward. An agreement has been entered into for the sale of the undertaking to the Glasgow Corporation. The Corporation is applying for a provisional Order to confirm the sale.

Dublin United (Electric) Tramways Co., Ltd.

Mr. Joseph Mooney, presiding at the annual meeting, in Dublin, said that as compared with 1921, there was a slight falling off in total receipts, notwithstanding that in the first six months they had continuous increases, amounting in all to £40,507. The disturbed conditions that arose in the city in June changed the position, and traffic fell away. The increase was not only wiped out, but a deficit of £236 was shown in passenger receipts for the twelve months. There was a saving in expenses of £39,410; £27,042 being due to a substantial reduction in price of coal, the price per ton averaging 24s. 0½d. as against 49s. 8½d. in the previous year, being the lowest average since 1915. The net result of the next year gave a balance to credit of profit and loss account of £161,742. The company collected 81,310,052 fares, ran 7,101,596 passenger car miles, and generated 14,755,000 kWh. Traffic wages, notwithstanding reductions in the cost of living, only showed a decrease of £4,970; while a reduction of 4s. per week was agreed to, this was counter-balanced by a claim subsequently made by the men for reduced hours on Sundays and a week's holiday with pay, with relief in wages, as in the case of other tramway undertakings. The reduction in working expenses would enable them to proceed more rapidly with relaying of tracks, improvement of cars and an altogether better service to the public. There was little hope of widening the scope of employment while present conditions remained. They would like to replace a lot more of the open cars by top-covered cars of standard size.

S. Smith & Sons (Motor Accessories), Ltd.

The accounts for the year ended August, 1922, show a loss on trading for the first six months of £25,822 and a trading profit on the second half of the year of £13,166, leaving the actual loss on trading £12,656. Subsequent to the recent Motor Show the turnover was nearly double that for the same period last year, and the company is trading at a profit after allowing for interest, but excluding depreciation. In addition to the trading loss of £12,656, depreciation of plant required £21,333, interest £34,188, bad debts £1,406, depreciation of stock £162,098, loss on overseas branches (mainly arising from falling values) £34,051, and loss on cancelled contracts and Government £23,560, making, after deducting the refund of excess profits duty and income tax, £24,947, a deficit of £264,335, to which must be added the debit balance brought in of £203,985, making to be carried forward £468,320. Substantial orders are on hand assuring a further increase in turnover, and the directors consider that steps should now be taken to deal with the adverse balance standing on the profit and loss account and the sum invested in subsidiary companies.—*Financial Times.*

French Electrical Companies.

Omnium Français d'Electricité.—The accounts for the year to June 30th last showed gross profits of 1,807,485 fr., including a balance brought forward of 235,776 fr., the excess of receipts over outlay totalling 916,276 fr. After provision for various charges, an available balance of 460,505 fr. resulted, from which a dividend of 4 fr. per share was declared. The company has taken part during the year in the increase of the capital of the Energie Electrique Maine-Anjou, which embraces a network of 373 km. It has parted with its interests in the Meaux region, so as to devote all its energies to the West of France, and more particularly to the Eure-et-Loire, Orne, Sarthe, Ile-et-Vilaine and Côtes-du-Nord departments. It has, besides, lent its help to the development of the following companies; the Electrique de Bretagne, Société du Gaz et de l'Electricité de Nogent-le-Rotrou et Extensions, Société Energie Electrique de la Manche and Secteur Electrique de Chartres, which are about to be embodied as a company with 1,000,000 fr. capital. The Omnium, which feeds to-day, by itself and its offshoots, 164 communes, has extended its field of action to Algeria and Tunisia, where several concessions have already been secured, notably at Ain-Berda, Tebassa, Kairouan and Beja.

Forces Motrices du Réfrain.—The ordinary meeting of this company passed the accounts of the last working year, showing a profit of 460,398 fr. The company's output had risen to 23,610,910 kWh, contrasted with 23,002,680 kWh in the preceding year.

German Capital Transactions.

Among other German companies which have given notice of intended repayment of their gold debentures in paper marks are mentioned the Electricity Co. (late Schuckert), of Nuremberg, and the Continental Co., for Electrical Undertakings, of the same city.

It is proposed to increase the ordinary share capital of the Electricity Co. (late Lahmeyer & Co.), of Frankfort-on-Main, by 60 millions of marks to 120 millions, and to make an issue of 6 per cent. preference shares for 10 millions, with multiple voting powers. The new capital is required for strengthening the working funds, partly covering the financial needs of subsidiary companies and for participating in new undertakings.

The share capital of the Welter Electricity & Lighting Appliances Co., of Cologne, is to be increased, although the amount has not yet been decided.

Central Electric Supply Co., Ltd.—Particulars are now published by the directors of the terms of the alternative proposal which they make to their previously issued intention to redeem, on April 1st, 1923, the £500,000 eight per cent. secured and guaranteed notes issued in April, 1921. The alternative is for the notes to be repayable at par on April 1st, 1926, without the option of previous redemption by the company; the notes will bear interest as from April 1st, 1923, at the rate of 5½ per cent. per annum, in lieu of the present rate of 8 per cent. The holders of the notes accepting this proposal to receive a payment of £2 per cent. in cash on April 1st, 1923, in addition to the half-year's interest then due.

Indian Electric Supply and Traction Co., Ltd.—An extraordinary general meeting is to be held at the offices in London on Monday next, when a resolution will be proposed altering the name of the company to The Cawnpore Electric Supply Corporation, Ltd. The purpose of the change is to indicate the field of the company's present operations. The City of Cawnpore is a very active centre of trade and industry and its rapid development offers ample scope for the extension of the company's operations without exploring new fields. The company will still be able to do business elsewhere if it should become advisable.

Pirelli-General Cable Works, Ltd.—In order to comply with Stock Exchange Regulations, particulars have been published in the daily Press of the creation on January 31st, 1923, of £300,000 six per cent. first mortgage debenture stock. Out of the proceeds of the sale of this stock the £200,000 7½ per cent. three-year notes now outstanding and due for repayment in August next, will be paid off. The stock has been purchased from the company at the price of 90 per cent. by British Trusts Association, Ltd., who, after paying certain commission and expenses, have re-sold it at 92½ per cent.

Mersey Railway Co.—The receipts during 1922 were £240,038 and the expenses were £165,237, leaving £74,801, plus £9,345 miscellaneous receipts and £207 brought forward, making £84,353. After meeting interest, rental, and other fixed charges, putting £6,000 to depreciation and renewals, paying £26,907 for interest on contingent debenture stocks, and a dividend of 2 per cent. on the 3 per cent. perpetual preference stock (which absorbs £12,981), £1,798 remains to carry forward.

Lancashire United Tramways Co.—The report for 1922 shows a profit on the combined undertaking of £35,151. Interest and dividends received from operating company, &c., amounted to £77,626. After deducting motor coach and other expenses, interest on prior lien debenture stock, and depreciation, there remains a balance out of which interest at 2½ per cent., less tax, will be paid on second mortgage debenture stock for 1922. £230 remaining is carried to depreciation account.—*Financial Times.*

Mansfield and District Tramways Co.—After putting £1,255 to reserve and paying the debenture interest and preference dividend, a further dividend of 6 per cent. on the ordinary shares is recommended, making 9 per cent., less tax, for the year. £1,362 is to be carried forward.

Reduction of Capital.—Kalgoorlie Electric Light and Power Corporation, Ltd.—A petition for the confirmation of the reduction of the capital of the company from £225,000 to £50,005 has been presented to the High Court, and will be heard in London on March 6th.

Calcutta Electric Supply Corporation, Ltd.—Dividend of 6d. per share net (at the rate of 5 per cent. per annum) on the £1 cumulative preference shares for the half year ended December 31st, 1922.

Crossley Brothers, Ltd.—According to the *Financial Times* the accounts show a loss of £66,259 for the year, increasing the debit balance brought in to £120,448. No dividends on the ordinary or the preference shares are likely.

Uxbridge and District Electric Supply Co., Ltd.—It is proposed to pay a dividend of 8 per cent. on the ordinary shares, placing £19,000 to depreciation fund and carrying forward £692.

County of London Electric Supply Co., Ltd.—Final dividend on the ordinary shares at the rate of 14 per cent. per annum., making 10 per cent. for the year as against 8 per cent. for 1921.

South London Electric Supply Corporation, Ltd.—Final dividend on the ordinary shares at the rate of 15 per cent. per annum, less tax, making 10 per cent. for the year, and a bonus of 1 per cent.

Clontarf and Hill of Howth (Electric) Tramways Co., Ltd.—Dr. Lombard Murphy presided at the annual meeting, when a dividend of 3 per cent., less tax, was declared.

Yorkshire Electric Power Co.—The annual meeting was held at Leeds on Tuesday, Mr. A. G. Lupton presiding. Our report of the proceedings will appear next week.

North Metropolitan Electric Power Supply Co.—Dividend on the ordinary shares at the rate of 10 per cent. per annum for 1922.

Liverpool Overhead Railway Co.—Dividend of 5 per cent., less tax, on the preference shares.

Telegraph Construction and Maintenance Co., Ltd.—Final dividend of 7½ per cent., free of tax, making 10 per cent.

Metropolitan Electric Supply Co., Ltd.—Final dividend of 6s. per share, making 8½ per cent. for the year.

STOCKS AND SHARES.

Tuesday Evening.

The main features of the market during the past business week reflect those of the previous fortnight. That is to say, the electric lighting list is exceedingly strong, with further advances in some of the leading shares. Home Railway stocks are good, the outstanding items of interest being sharp rises in Districts and Underground Electric Railways Income bonds. The St. Maurice Power Company's issue of 6½ per cent. debenture stock at 99½, guaranteed by the Shawinigan Water Company, proved an instantaneous success. The subscription lists were open for about half-an-hour, and applicants for £50,000 received no more than £300 stock. The price is 3 to 4 premium. In the engineering group, a rise in Babcock and Wilcox deserves attention.

Up to the time of writing, not all the electricity supply companies have declared their dividends, but the results so far achieved may be usefully set out in a table comparing the dividends for 1922 with those of the previous twelve months. We have already given the details in most of the cases, but in tabular form the improvements look even more imposing. They are as follows:—

Company.	Dividend. 1921.	1922.	Increase
	p.c.	p.c.	p.c.
Charing Cross	9	14	5
Chelsea	6	10	4
Kensington & Knightsbridge ...	10	12	2
London	4	10	6
Notting Hill	8s. p.s.	10s. p.s.	2/-
St. James'	12	14½	2½
South Metropolitan	10	10	—
Westminster	10	12	2

That the South Metropolitan Electric Co. should have declared only 10 per cent., the same dividend as in the corresponding period last year, came as something of a surprise, especially when the figures showed that the directors could have paid substantially more if they had chosen to treat the allocations in a less generous manner. There are still a few ordinary shares on offer, namely, Bromptons, Charing Cross, Chelseas, County Ordinary, Londons, Metropolitan and Westminsters. The amounts available in each case vary from two hundred shares to a thousand. In the preference list, it is more difficult to get anything like such a selection. There are two hundred Westminster 5½ per cent. cumulative £5 shares on offer at 4 7/16, the yield at which is £5 1s., or about the same as that on the War Loan. Debenture stocks are equally scarce, but a fair line of City of London Electric 4½ per cent. second debenture stock may come to market in the course of the next few days on the basis of 87½-88.

Coming to the changes which have occurred in prices, Charing Cross ordinary have risen 2s. 6d., Edmundsons preference, Metropolitans, and South Londons 5s. each. Kensingtons are ½ up, South Metropolitan preference and Newcastle-on-Tyne ordinary are both 1/16 harder; Bromptons gained 6d. The market is exceedingly firm, and there is every appearance of the strength being maintained. Outside the London shares, Whitehall Electric debenture has advanced to 92½, and the preference are better at 19s. 6d.

Underground Electric Income Bonds at 98 are 2½ higher, while the other issues remain unchanged. Districts jumped to 53, on a report that the Underground Electric Railways of London would take over the District on the same terms as those accorded to the Central London, where the ordinary guaranteed stock receives 4 per cent. dividends, and stands in the market at 68. Prompt contradiction, however, from the Underground Company caused a slight reaction to 52, at which Districts are still 3 points up on the week. British Electric Tractions at 71½ are 3 to the good.

Electric tramway stocks are firm throughout. Mexico Tramways firsts gained 3 and the sixes 2 points. Mexican Light & Power firsts at 64½ are 2 higher, Brazil Tractions at 52 show a rise of 3. London traction stocks and shares retain their improvements. British Columbia issues are unchanged. Cable stocks and shares are quiet, with a fall of 3 points to 186½ in Eastern Telegraph ordinary as the principal movement. This failed to affect the prices of the other three ordinary shares in the same group. Anglo-American deferred at 22½ is again harder, and United River Plates rose to 7½. Marconis advanced to 2 11/16 bid, but this induced selling, and the price reacted to 2½. Canadian Marconis have been nearly 12s., to go back, however, to 11s. 6d.

Automatic Telephones are active and strong, the price rising from 15s. to 17s. 6d. It is worth pointing out that the majority of these shares are held by the International Telephone Co., whose shares, however, stand at about 11s. 6d., though they should more appropriately be standing somewhere near the same level as that occupied by Automatics. It may be that the disparity will be redressed when the position becomes better appreciated.

Babcock & Wilcox at 3 11/16 are 5s. higher, the rise being due to rumours of absorption, of a higher final dividend, and one or two other reports of similar nature, all being extremely nebulous. British Insulated are good at 49s. 4½d., and General Electric preference stiffened to 22s. 9d. There is not much change otherwise in manufacturing shares, the market being quiet as a whole, but with a good under-current. Business in rubber shares has come to something like a stop, people being content to await the next developments. The iron and steel market is firmer, on the decision of the Welsh miners to work three shifts a day instead of two, but it cannot be said that the public show any particular anxiety to take an active hand in buying the industrial stocks and shares, although the strength of Home Railways is attributed to this factor.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend. 1920.	Dividend. 1921.	Price Feb. 20, 1923.	Rise or fall.	Yield p.c.
Brompton Ordinary	12	12	34/6†	+1/-	£8 9 8
Charing Cross Ordinary	8	9	9⅝	+ ⅜	7 1 9
do. do. do. 4½ Pref....	4½	4½	4⅞xd	—	5 7 5
Chelsea	6	6	8⅝	—	5 19 5
City of London	14	14	48/-	—	5 16 8
do. do. 6 per cent. Pref.	6	6	28/-	—	5 4 4
County of London	8	8	35/-	—	4 11 5
do. do. 6 per cent. Pref.	6	6	1⅛	—	5 4 4
Edmundson's Ordinary	Nil	Nil	2½	—	Nil
do 6 per cent. Pref.	6/-	12/-	4⅜	—	6 13 4
Kensington Ordinary	9	10	9	+ ⅛	6 13 4
London Electric	2½	4	4¼	—	3 16 2
do. do. 6 per cent. Pref.	6	6	5⅛	—	5 17 1
Metropolitan	7	7	7¼	+ ¼	4 16 7
do. 4½ per cent. Pref.	4½	4½	4 7/16	—	5 10 9
Newcastle-on-Tyne Ordinary	8	Nil	¾	+ 1/16	Nil
do 5 per cent. Pref.	5	5	15/9	—	6 7 0
do 7 per cent. Pref.	—	7	22/6	—	6 4 6
Notting Hill, 6 per cent. Pref.	6	6	9½	—	6 9 9
North Met. Elec., 6 per cent. Pref.	6	6	1 1/16	—	5 13 0
Urban Ordinary	Nil	Nil	1¼	—	Nil
do 5 per cent. Pref.	2½	2½	4⅛	—	6 1 3
St. James' and Pall Mall	12	12	10½	—	6 18 1
South London	7	7	5	+ ¼	5 12 0
South Metropolitan Pref.	7	7	1¼	+ 1/16	5 12 0
Westminster Ordinary	10	10	9	—	5 11 1
Whitehall Elec. Inst., 7½ per cent. Pf.	—	7½	19/6	+6d.	7 13 10

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	6	6	103½	—	5 16 0
do. Def.	1½	84/6	22⅜	— ½	6 14 4
Chile Telephone	6	6	8⅛	—	4 16 0
Cuba Sub. Ord.	7	7	7⅞	—	9 0 8
Eastern Extension	10	10	19	—	5 5 3
Eastern Tel. Ord.	10	10	186½	−3	5 7 3
Globe Tel. and T. Ord.	10	10	19	—	5 5 3
do. do. Pref.	6	6	11⅛	—	5 7 10
Great Northern Tel.	24	22	97	—	8 2 0
Indo-European	10	10	85½	—	7 1 0
Marconi	25	15	2⅜	— 1/16	5 14 3
Oriental Telephone Ord.	12	12	2⅜	—	*4 11 5
United R. Plate Tel.	8	8	7½	+ ½	*5 10 4
West India and Panama	Nil	Nil	7/6	—	Nil
Western Telegraph	10	10	18⅜	—	*5 6 8

HOME RAILS.

Central London Ord. Assented	4	4	68	—	5 17 8
Metropolitan	1½	2½	61½	—	5 13 10
do. District	Nil	1	52	+3	5 15 5
Underground Electric Ordinary	Nil	Nil	3	—	Nil
do. do. "A"	Nil	Nil	7/6	—	Nil
do. do. Income	2	4	98	+2½	*5 2 0

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams. First Pref.	5½	13½	91½	—	7 19 2
do. do. 2nd Pref.	Nil	5½	38	+	8 5 6
do. do. 5 per cent. Deb.	5	5	82	—	6 2 0
British Electric Traction Ordinary	4½	—	71½	+3	6 5 10
do 6 per cent. Pref.	6	6	97	—	6 3 9
Brazil Tractions	Nil	Nil	53	+3	7 13 10
British Columbia Elec. Rly. Pcs.	5	5	81½	—	6 2 8
do. do. Preferred	5	93/-	76½	—	*6 2 6
do. do. Deferred	8	124/-	90½	—	*6 13 6
do. do. Deb.	4½	4½	76½	—	5 11 1
Lond. and Sub. Trac., 5 per cent. Pf.	2½	3½	12/-	—	8 6 8
London United Tram deb.	4	4	69½	—	6 8 0
Mexico Tram. 5 per cent. Bonds	Nil	Nil	31½	+3	6 2 8
do. 6 per cent. Bonds	Nil	Nil	59½	+2	Nil
Mexican Light Common	Nil	Nil	19½	—	Nil
do. Pref.	Nil	Nil	49½	—	Nil
do. 1st Bonds.	Nil	5	64½	+1	7 15 6

MANUFACTURING COMPANIES.

Babcock & Wilcox	15	15	3 1/16	+ ⅛	4 6 9
British Aluminium Ord.	10	5	17/9	—	5 12 8
British Insulated Ord.	15	15	2 1/16	+ 1/16	6 1 6
Callenders	15	15	2 1/16	—	6 18 4
do. 6½ Pref.	6½	6½	1 1/16	—	5 9 5
Crompton Ord.	10	5	17/6	—	5 14 4
Edison-Swan	10	Nil	3/3	—	Nil.
do. do. 5 per cent. Deb.	5	5	61	—	8 1 4
Electric Construction	10	10	1⅜	—	7 5 6
English Electric	8	5	17/3	—	5 16 0
do. do. Pref.	6	6	1 1/16	—	5 16 3
Gen. Elec. Pref.	6½	6½	22/9	+6d.	5 19 6
do. Ord.	10	5	19/3	—	5 4 0
Henley	15	15	2 1/16	—	6 8 0
do. 4½ Pref.	4½	4½	4⅜	—	5 2 10
India-Rubber	10	—	12/9	—	—
Met.-Vickers Pref.	8	8	2 1/16	—	6 11 2
Siemens Ord.	10	10	19/6	—	Nil.
Telegraph Con.	20	20	26⅜	—	*4 11 6

* Dividends paid free of Income Tax.
† New shares.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances

CHEMICALS, &c.	Price February 21st.	Fortnight's Inc. or dec.
a Acid, Oxalic ... per lb.	6¾d.	...
a Ammoniac, Sal ... per ton	£63	...
a Ammonia, Muriate (large crystal) ,,	£48	...
a Bisulphide of Carbon ... ,,	...	...
a Borax ... ,,	£28	...
a Copper Sulphate ... ,,	£26 15s.	...
a Potash, Chlorate ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ,,	6½d.	...
a Shellac ... per cwt.	£19	...
a Sulphur, Sublimed Flowers ... ,,	£9	...
a ,, Lump ... ,,	£8 10s.	...
a Soda, Chlorate ... per lb.	3½d.	...
a ,, Crystals ... per ton	£6	...
a Sodium Bichromate, casks ... per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots ... per ton	£100	...
b ,, Wire ... per lb.	1/9 to 2/6	...
b ,, Sheet ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... per ton net	£177	£5 inc.
Grade II ... ,, ,,	£128	£2 inc.
Grade III ... ,, ,,	£73	£2 inc.
c Brass (rolled metal 2' to 12' basis) per lb.	9½d.	...
c ,, Tubes (solid drawn) ,,	1/0½ to 1/0½	½d. inc.
c ,, Wire, basis ... ,,	10⅜d.	½d. inc.
c Copper Tubes (solid drawn) ,,	1/2	½d. inc.
c ,, Bars (best selected) ... per ton	£100	£2 inc.
c ,, Sheet ... ,, ,,	£100	£2 inc.
c ,, Rod ... ,, ,,	£100	£2 inc.
d ,, (Electrolytic) Bars ... ,,	£76 10s.	£4 inc.
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ... ,,	£86 10s.	£4 inc.
d ,, ,, H.C. Wire per lb.	10½d.	½d. inc.
f Ebonite Rod ... ,,	3/6	...
f ,, Sheet ... ,,	3/-	...
n German Silver Wire ,,	2/6	...
h Gutta-percha, fine ... ,,	5/6	...
h India-rubber, Para fine ... ,,	1/5	...
i Iron Pig (Cleveland Warrants) ... per ton	92s. 6d.	...
i ,, Wire, galv. No. 8, P.O. qual. ,,	£94	...
g Lead, English Pig ... ,,	£29 15s.	10/- inc.
g Mercury ... per bot.	£10 5s.	2/6 to 5/- dec.
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium ... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/1½	½d. inc.
p ,, drawn bars and rods ,,	1/3½	½d. inc.
p ,, rolled strip & sheet ,,	1/3	½d. inc.
p ,, wire ... ,,	1/4	½d. inc.
o Platinum ... per oz.	£23	£2 dec.
d Silicium Bronze Wire ... per lb.	1/0½	½d. inc.
r Steel, Magnet, in bars ... ,,	10d.	...
n Tin, Block (English) ... per ton	£192 to £193	£9 inc.
n ,, Wire, Nos. 1 to 16 ... per lb.	8/2	...

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Switch and Circuit-breaker Specifications.—The British Engineering Standards Association has published the following specifications: No. 109, 1923, "Air-break Knife Switches and Laminated Brush Switches for Voltages not exceeding 660 volts"; and No. 110, 1923, "Air-break Circuit Breakers for Voltages not exceeding 660 Volts." These specifications were first issued in 1921, but it has been found necessary to revise the sections covering the tests. As in the first editions, the specifications do not include switches or circuit breakers for use with series motors, circuits of high inductance, or traction circuits, all of which may require a higher breaking capacity than is specified. A distinction between an isolating switch, a switch, and a circuit breaker is laid down as follows: "An isolating switch is intended only for interrupting the circuit when there is no load-current. A switch is suitable for breaking a load-current; and a circuit breaker is suitable for interrupting abnormal conditions, such as that of short circuit." A number of terms used in modern switchgear practice have been defined and a series of standard sizes has been included. Since it is not practicable to make a complete range of tests on every switch or circuit breaker the tests have been divided into two categories, *i.e.*, tests which are carried out on every switch or circuit breaker and those which are carried out on a switch or circuit breaker of a type.

Copies of the specifications may be obtained from the offices of the B.E.S.A., 28, Victoria Street, S.W.1, price 1s. net, post free 1s. 2d. each.

New Electric Tractor.—A new electric tractor for boats, invented by an engineer of Liége, has passed its trials successfully, and is reported to have given excellent results.—*Financial Times.*

VARIABLE-SPEED A.C. MOTORS (WITHOUT COMMUTATORS).

Discussion at Leeds.

MR. F. CREEDY's lecture on the above subject (which was abstracted in our issue of January 12th) was delivered with the aid of lantern slides at the NORTH MIDLAND CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS on January 9th, when Mr. W. B. Woodhouse presided over a good attendance.

Questions were asked by Mr. J. C. INGLEBY (Leeds), and replied to by the lecturer, after which Mr. W. HOWARD BROWN (Shipley) congratulated Mr. Creedy and Mr. Parkinson on the manner in which they had stuck to that problem for a number of years. The illustration of the switchgear showed how much it had been simplified. His difficulty was that he got many demands for variable-speed motors of one kind and another. A range of 4 to 1, sometimes 5 and 6 up to 1, was the sort of thing he would like. In a good many instances he had to compete against steam engines where the range of speed was more than one could offer with a motor except with a rheostat controller, which was expensive. Fixed speed was a very troublesome point in the industry with which he was connected. He often wished that they could get a good number of intermediate speeds with the synchronous values of the motors, but owing to the big jumps the thing was out of the question and one was forced to consider some sort of converting gear—a thing he did not like doing. There was no doubt that the machines with the switchgear were relatively expensive when one came down to a size of from 30 to 60 horse power to give a speed range which was in common use.

The CHAIRMAN (Mr. W. B. Woodhouse) said they were all rather unready to discuss the paper. Consideration of the efficiencies at the various speeds of a Creedy motor, as compared with a slip-ring motor, wherein the speed regulation was obtained by resistance in the motor, and as compared with any recognised type of commutator motor, would drive home a little more clearly the great advantage of those different speeds which could only be obtained from the Creedy motor. Regarding the necessity for some purposes of smooth regulation from one speed to another, one remembered that for other purposes it was a great advantage to have a stable speed if the load varied. Again, in some cases they particularly wanted constant torque at all speeds. The comparison of cost with that of the induction motor was extremely valuable and if all the conditions were compared in that way they would be able to say much more readily which type of motor they should use for any particular purpose. The "Cascade" synchronous motor was particularly interesting, because, from the supply point of view, it not only did not draw magnetising current from the line, but sent some back, so that they could supply that type of motor very cheaply.

In replying to the discussion, Mr. F. CREEDY said that no motor covered every requirement. A machine with a small expanding pulley could be made to give continuous speed variation from one range to another, combined with the characteristic that the speed did not vary appreciably with the load. As to the shunt characteristic at all speeds, that could be done certainly at a lower price than that of the Williams Janney gear with a much higher efficiency.

As to the consideration of converting plant to operate a considerable number of motors, was it true that it was financially favourable? A comparison would not be very favourable even on first cost, but if they took an efficiency basis the comparison was really absurd. It meant an annual charge which would very soon not only wipe off the difference in the first cost, but go on adding up year by year.

The losses in his motors were practically the same at all speeds, so the efficiency was highest at top speed when the machine was giving its greatest power, and it fell off as the speed went down to a small extent. It was also possible to supply them with a constant horse-power characteristic which was usual for some classes of machine tools. Of course, the efficiency of such a multi-speed motor was perhaps about 85 to 90 per cent.—that of a machine controlled by rotor resistance was not over 50 per cent., and the first costs of the two were very nearly the same.

He was a strong believer in the commutator machine for many purposes, and there was a commutator machine on the market which gave continuous speed variation. In that machine they lost about 10 per cent. in efficiency as against the multi-speed machine, and the first cost was not nearly so favourable.

Discussion at Birmingham.

Mr. F. CREEDY's lecture was also delivered at the South Midland Centre of the Institution on January 10th, and in opening the subsequent discussion

Mr. R. A. CHATTOCK said that Mr. Creedy's multi-speed "Cascade" motor seemed to cover all the requirements under ordinary working conditions, and the only questions were whether this type of machine had been run in commercial service long enough to show that it was reliable, and whether the large number of terminals and connections involved would prove to be a source of weakness.

With the variable-speed induction motor, in order to change the speed, it was necessary to break the main circuit, which fact would prove to be a disadvantage under many conditions of service. Once the circuit of the variable speed synchronous induction motor was interrupted, it would at once go out of step and it would have to be re-synchronised—an operation that would in most cases prove to be quite unworkable in practice.

Mr. M. L. KAHN thought that Mr. Creedy himself appeared to recognise the limitation of his invention, and the limits of 19 and 21 compared with 20 r.p.m. mentioned in the paper were rather optimistic, as the table of speeds showed the step might be from 20 per cent. to 30 per cent. for the most favourable, and incidentally very costly, arrangement, and from 30 per cent. to 50 per cent. in ordinary cases. Normally, coils were wound with a coil span of about one pole pitch; they might be lengthened or shortened up to 33 per cent. without affecting the output of the machine materially. This meant that a winding with a span corresponding to a pole pitch of eight poles could be used for six or 10 poles. For six poles the pitch was 0.75 of full pitch, and for 10 poles the pitch was 1.25 times full pitch. If the same winding was, however, to be used for a speed range 428/1,000, *i.e.*, for six and 14 poles as mentioned on page 8 of the paper, it would, if wound for a mean pitch, have a span which differed 40 per cent. from the normal value for the two limits of the speed range. That would tend to reduce the output obtainable from a given size of machine for the extreme limits of the speed range.

The method of pole changing proposed involved complications that could only be justified in cases where speed variation was absolutely essential.

Mr. G. M. HARVEY confined his remarks to the Hunt "Cascade" motor. The advantages of this motor for mining work were that the even torque obtained at "crawling" speeds was of great advantage for haulage work, as it prevented "snatching" at the rope; the starting characteristics of a slip-ring motor were obtained without the danger and inconvenience of the use of slip rings, and a low-speed motor was obtained which compared very favourably in bulk with a plain induction motor running at the same speed. In this connection, it seemed that the advantage claimed by Mr. Creedy for recent improvements which enabled the "Cascade" motor to be run at 1,000 r.p.m. were illusory, since the chief advantage was the exceedingly low speed which could be obtained with a reasonable efficiency.

Mr. F. W. CLOSE said the time required to change the interconnections of a six-speed set was practically determined by the natural speed at which the contactors would open and re-close; it could be done in something like half a second, which was about a quarter the time mentioned by Mr. Creedy. During a part of the time taken to change over, the supply was cut off from the motor and, therefore, it would commence to fall in speed. With regard to the control of a machine-tool driven by a three-speed motor, and the quite reasonable fear that the operator might move the handle in anything but an ideal manner, the speaker said he had seen running the three-speed motor and the controller which Mr. Creedy had exhibited. The motor was belted up to another machine, and the controller handle was rotated rapidly from "off" to "full" speed, and then back again many times in rapid succession, without pausing on the intermediate steps. No trouble arose; the only thing noted was the squealing of the belt due to the rapid acceleration produced by the torque exerted.

Mr. W. G. LINE explained a suggestion which might enable the advantages of Mr. Creedy's system to be obtained on single-phase supplies and, in addition, the same principle developed on polyphase supplies might enable the transformer which Mr. Creedy found necessary, to be replaced by other apparatus which might be cheaper.

Discussion at Newcastle-upon-Tyne.

Mr. F. CREEDY lectured on the same subject at the North-Eastern Centre of the Institution on January 22nd. Mr. F. G. C. Baldwin presided, and in opening the short discussion that followed

Mr. C. H. DAVIDSON said if multi-speed motors were to be brought into general use they must be absolutely reliable, and they must have a standard.

Mr. F. H. DOWNIE said the paper left much to be explained. In a three-phase single-speed motor they got a harmonic about 1-7th of the whole speed. Had the motors of Mr. Creedy shown any sign of this? A further point was that of limitation as to the number of poles. Could a machine be built with 22, 24, or 26 poles, or must there be definite gaps? For some purposes he could well imagine such machines being required.

Mr. J. W. JACKSON had been rather biased against Mr. Creedy's type of machine by his experience with one of the earlier types. Some of the earlier troubles were due rather to faults in the commercial organisation than technical construction, for when they got through to the right people

their troubles disappeared almost as if by magic, but it was not easy to get through to the right people, and the commercial organisation seemed to leave much to be desired. In colliery compressor work in particular there seemed to be a great field for a motor of that type, but people were shy apparently of incurring the cost and also, perhaps, doubtful as to reliability.

Mr. A. T. Robertson spoke appreciatively of the lecture, but said there were many details upon which more information was needed. For instance, when connecting a motor of that type to a two-phase supply, would he put in a transformer to convert from two to three-phase?

Mr. C. Turnbull thought users of electric power did not take sufficient advantage of multi-speed motors; when it was suggested that the consumer should pay something for variation of speed he generally demurred, and seemed more willing to pay for the extra current used than the capital cost of a more economical machine. To facilitate the adoption of these machines some explanation might be given of their worth from a commercial point of view.

Dr. Thornton raised the question whether there was any limitation as to size.

Mr. F. Creedy briefly replied to some of the points raised. The whole of the windings, he said, were in use at all speeds. Regarding harmonics, there was no trouble at the high speed; at the low speed it was the same as an ordinary machine. The overload capacity varied with the speed; on the low speed it was rather small, but on the high speed it was very ample. He did not think they could get more than three or four speeds out of a 10-h.p. motor; if they did they had to make some sacrifice. There need be no confinement of the design to motors of a comparatively small size, and he did not see any reason why they should not be built in very large capacities.

HIGH-SPEED ALTERNATORS.

Some Problems and their Solution.

By J. ROSEN, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

High speeds of rotation are essential to direct-coupled, steam-turbine-driven machinery. The frequency for most electrification schemes in this country, however, is 50 periods, and limits the alternator speed to 3,000 r.p.m. which, whilst suitable for moderate outputs, is not sufficiently high to enable the best economy to be realised in turbines of 1,000 kW and below, a circumstance which has led to the development of geared turbo-alternators for these outputs. Modern single-reduction gears enable a turbine to be run up to 5,000/6,000 r.p.m.; the speed of the alternator, now being optional, is made low (500/750 r.p.m.), so that ordinary materials and low-speed construction may be adopted, with a view to reduced cost. Whereas alternators of 20,000 kVA continuous maximum rating have been manufactured in this country, in America, at present, 9,375 kVA continuous maximum rating is the largest output at 3,600 r.p.m. In America the difficulty in designing at the higher speeds lay in the alternator and not in the turbine, and ventilation appeared to be a limiting factor, but large alternators at high speeds are certainly no less reliable than the earlier and smaller machines.

In one plant some of the stator conductor insulating-tubes were eroded. Fine grit and dust were drawn into the air-duct and air-gap, being thrown out by the rotor at a velocity corresponding approximately to its peripheral speed, causing a sand-blast action sufficient to cut into the portions of the insulating tubes exposed between the core sections. The remainder of the tubes were protected by the core as the slot was of the tunnel formation. Although at least seven conductor bars were bared to the copper, the alternator did not break down. Protection is now provided by means of teak wood packing at the top of the slots, driven in along the whole length of the core. The above fault was found during the annual overhaul, and emphasises the advisability for periodic examination and testing.

Rotor.—The barrel rotor, in which the exciting windings are embedded in radial slots formed between the poles, has proved itself eminently suitable for high-speed design, and experience has shown that the simple solid forging is the most suitable construction.

When the first 14,700-kVA. 2,400-r.p.m. alternators were constructed in 1914, a peripheral speed of 300 ft. per sec. was chosen, which meant a long rotor body, *i.e.*, actually 105 in. with a diameter of 29 in., giving a ratio of pole length to pole diameter of 3.62, or more than double that of any large alternator either running or under construction at that time. After the final balancing no undue vibration could be detected at or below 3,000 r.p.m., *i.e.*, 25 per cent. above the normal speed. In addition to other novel features, the rotors were water-cooled. The caps for supporting the rotor and windings are one of the limiting factors in any design, and it is here that the advantages of comparatively low peripheral speeds become apparent. The material now obtainable for the caps has an ultimate strength of 65 tons per sq. in., with a yield point of not less than 48 tons per sq. in. The material is also ductile, as shown by the elongation on a test piece 0.564 in. diameter (area=0.25 sq. in.), of 15 per cent. on 2 in., with a reduction of area of 50 per cent. With the comparatively low peripheral speed the stress in the caps is kept below 12 tons per sq. in. at the normal speed; in the 14,700-kVA alternators the mean hoop stress in the caps was less than 9 tons per sq. in.

The rotor end windings are not evenly distributed under the caps, a circumstance that leads to the drawback that the caps, not being uniformly stressed, tend to become oval in service. Moreover, it is possible to deform a cap 25 in. diameter, 1 in. thick, by as much as ¼ in. on the diameter during its assembly over the windings. This phenomenon was investigated in 1921, the eccentricity of the cap being obtained by measuring the varying clearances between the cap and a fixed point or contact by photographing the length of an electric spark jumping across the gap between a fixed contact and the cap. The maximum extension of the cap occurred adjacent to the rotor body, the extension on the diameter being 0.01 in. between poles, and 0.025 in. at the centre of the poles. The cap was therefore only slightly distorted and the results agreed very closely with calculation.

Stator Windings and Insulation.—The conductors in the core are now made separate from the end connectors. The former are made by Messrs. C. A. Parsons & Co., of their stranded coreless cable, fig. 1, in which the individual strands are insulated and spiralled in a definite lay, to eliminate eddy-

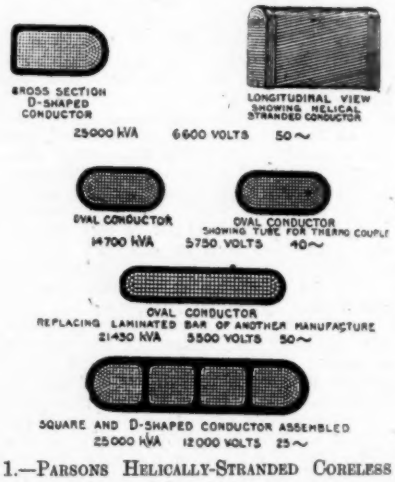

CROSS SECTION D-SHAPED CONDUCTOR
LONGITUDINAL VIEW SHOWING HELICAL STRANDED CONDUCTOR
25000 kVA 6600 VOLTS 50~
OVAL CONDUCTOR
OVAL CONDUCTOR SHOWING TUBE FOR THERMO COUPLE
14700 kVA 5750 VOLTS 40~
OVAL CONDUCTOR REPLACING LAMINATED BAR OF ANOTHER MANUFACTURE
21450 kVA 5500 VOLTS 50~
SQUARE AND D-SHAPED CONDUCTOR ASSEMBLED
25000 kVA 12000 VOLTS 25~

Fig. 1.—Parsons Helically-Stranded Coreless Cable.

current losses in the cable. The end connectors are copper straps, which form a good mechanical construction for bracing against the forces set up in the winding at the moment of sudden short-circuits.

The cable employed is constructed on a special cable-making machine and is built up of copper strands separately insulated; it can be manufactured in any desired shape without a central core and without crushing. There is, therefore, no necessity to deform the cable after it leaves the cable-making machine and the danger of short-circuits developing between individual strands is eliminated. The Parsons patented cable is gradually obtaining recognition, so that it is being used in the construction of transformers and alternators by other manufacturing firms in this country and on the Continent; in America its use is now under consideration. Multiple joints connect the cables forming the core conductors to the end connectors. This improvement is successful in minimising the loss due to eddy currents induced in the joints. An

example of a conductor with three separate joints at each end is given in fig. 2.

With the improved winding construction mica is the principal component in the material of the insulating tubes, the slot insulation being moulded round the conductors, forming one bar ready for placing into the slot. The end connectors are also insulated separately before assembly in the stator; after assembly it is only necessary to insulate the joints connecting the end windings with the slot conductors. With these new methods it has become possible to use improved insulating materials and to supervise more strictly the work.

To remove the expansion difficulty, and to retain the insulating tube moulded directly on to the conductors, it is necessary to use an insulation having the same coefficient of expansion as that of copper, or, alternatively, to make the insulation sufficiently flexible to take up the difference in expansion. The former solution is not yet obtainable. A flexible mica insulation was therefore obtained, and, when the spirit has been evaporated from the varnish binding the mica flakes together, the remaining oils ensure that the insulation retains sufficiently elastic properties at the operating temperatures of the alternator. It must be remembered that the sides of the conductor slots also grip the insulating tube; just as between the copper conductor and the tube there is relative movement, so also is there between the tube and the iron core. Flexible insulation has provided a satisfactory solution of both difficulties.

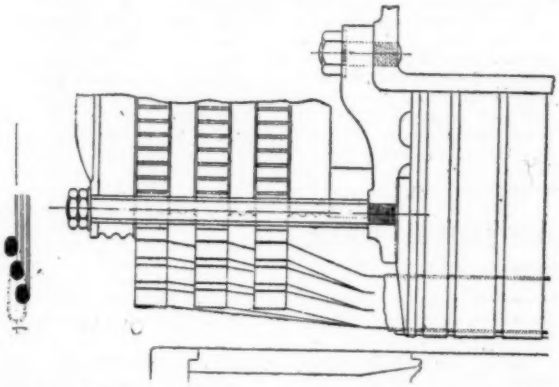


Fig. 2.—Multiple Joints for Stator End Connections.

As an alternative, if a hard moulded insulation is used, a thin layer of flexible insulation should be applied between the conductor and the hard tube, and also outside the latter. This outer layer of elastic material might be applied to the sides of the slots so as to present a smooth surface to the insulating tube. A suitable bituminous compound, becoming elastic at the operating temperatures, would serve the purpose. Whatever insulation is employed must not be brittle, or else cracks will also develop on short-circuits. The insulation must not pulverise. Too much stress cannot be laid upon these qualities. Movement of the end windings as a whole cannot entirely be prevented.

Stator Slots.—The tunnel slot for receiving the stator conductor bars has many advantages over the open slot. The construction may be a little more expensive to manufacture, but the windings are more accessible.

The slot is punched with a full radius top and bottom, giving a sound mechanical construction of core, and the insulating tube, of the oval cross-section required to fill the slot, is readily moulded around the conductor bar. The flux pulsations are minimised and, as the stator bore has an uninterrupted contour, the circulating currents induced in the rotor body are reduced to a minimum and the efficiency of the alternator is improved. Again, it is possible to obtain an alternator voltage wave-form entirely free from ripples. There are no pronounced harmonics, and on load the maximum deviation from a sine wave of the pressure between the line terminal and earth is 2.1 per cent. This improvement is most desirable, especially where the supply of power is given through transformers or converting apparatus. It avoids disturbance in telephone operation and difficulties with parallel running, since it eliminates circulating currents, and it gives the supply engineer opportunities to earth without anticipating trouble. If tooth ripples are present in the voltage wave-form there is the danger of resonance in the distribution system causing breakdowns of the cable insulation.

Ventilation.—To obtain ventilation by which the alternator shall be cooled uniformly throughout its entire length, the machine is divided into separate air circuits in parallel, each with low resistance to the passage of the air, which fig. 3 shows is forced into the separate pressure belts or compartments A, cast into the stator casing, alternating with the exhaust compartments B throughout the length of the alternator. From each pressure compartment the air passes through radial ducts into the body of the core. A portion of the air then passes between the stator teeth K round the conductors into the air-gap, where it divides and passes axially in both directions, and back radially into the adjacent compartments B. Only a portion of the air passes between the stator teeth K, the remainder being short-circuited through axial holes M in the core immediately behind the conductor slots; this air joins the stream passing from the air-gap back into the exhaust compartments. The stator end windings are ventilated from the end pressure compartments A_1, from which the air is forced through suitably-designed holes C in the end walls of the casing on to the end windings. Baffles are provided to direct the air round these windings before leaving at the outlet D in the end-winding protective shields

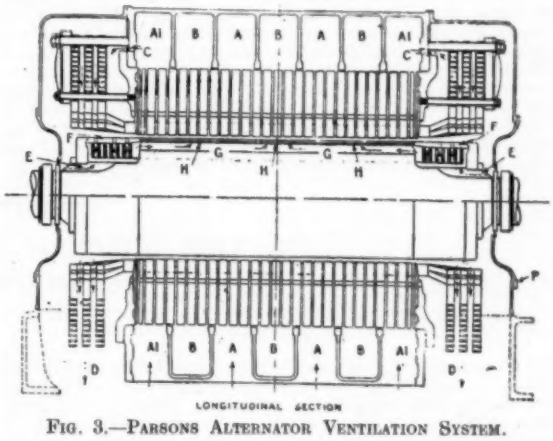


Fig. 3.—Parsons Alternator Ventilation System.

P. These baffles are so designed and arranged that the cool aid impinges on each section of the end windings, eliminating hot spots.

The rotor is mainly surface cooled, but, in addition, air is also drawn in under the balancing disks E. A portion of this air is forced through the holes F in the rotor end caps, and the remainder is drawn into the axial slots G machined along the rotor poles. Gaps H between the keys in these ventilating slots throw the air out opposite the exhaust compartments in the stator casing.

A separately-driven fan is recommended. It is impracticable to construct a highly efficient fan for fitting on the ends of the alternator rotor, and when integral fans are used sufficient air is passed only at the expense of unnecessary power and consequent loss of efficiency. It is also impracticable, without increasing the length of the plant unduly, to obtain a suitably-designed vortex chamber in the end shields, owing to the restricted space available, and to the baffling effect of the stator end windings. The motor-driven fan can be designed with the maximum efficiency, and it has been proved that a consequent gain of 1 per cent. in efficiency of the alternator is possible.

(To be concluded.)

Discussion in London.

Dr. S. P. Smith praised certain consulting engineers' initiative in installing pioneer plant, because they must all work together if they were really to show what they could do. With regard to ventilation, they were limited by the air channels as to the amount of air they could get through a machine, and the only alternative was, therefore, to reduce the losses. The weakness of modern large machines was in the stator and not the rotor. Greater care must be exercised when making the stator core and in the elimination of hot spots. The laminations could not be handled too carefully as it was a very easy matter for the iron loss to be increased from 1 to 2 per cent. of the output of the machine. He did not favour a long core with a small diameter because it was more difficult to cool, and suggested that if their designs were on the opposite lines they might, perhaps, not need to develop cooling devices as described in the paper.

Mr. W. M. Selvey pointed out that the paper showed the enormous development that had been made since Mr. A. B. Field's paper of 1918. Flexible mica insulation was of considerably more importance than was indicated in the paper. They wanted something that would conduct heat but not electricity, and there was a possibility that some new insulating materials that he was now testing which, for the want of a better name, might be termed "solidified colloids," might eventually displace mica. Was it not possible to generate at higher pressures and so reduce the current and save copper? They had reached a point when more attention must be given to the problem of getting the cooling air out of the machine. He thought there must be something fundamentally wrong about the author's conclusions with regard to the field switch; if it was dangerous to use that device was there no other method of attaining the desired result?

Mr. G. W. Partridge explained that a single-phase railway supply involved many short circuits and was a very severe

test for the generators, and he suggested that all new machines might be subjected to a single-phase test. The overhang of the end coils of the author's machine seemed to be excessive, and the support of the coils at their leaving point was very important indeed, because in modern generators it was a more difficult problem to "keep the copper within the insulation than to keep the current in the insulation." The closed-circuit system of air cooling was sound, but the necessity for a separate fan motor added another weak link to the chain of auxiliaries on which the main machine depended.

Dr. W. M. Thornton said that the reversal of the voltage of the exciter could be eliminated by the use of resistance between the exciter and the main machine. That, of course, involved a certain loss, but it was for the station engineer to choose the lesser of two evils. After drawing a diagram to illustrate a simple new method of killing the field of a generator, he drew attention to the fact that a Parsons alternator at Newcastle had successfully withstood a very large number of short circuits, the only result being that the dust in the machine was efficiently expelled, and seriously suggested that that might be a practicable method of cleaning generators.

Mr. H. W. Taylor exhibited a number of lantern slides illustrating the fact that B.T.H. developments were in some respects parallel to those of Messrs. Parsons but divergent in others; their end windings differed considerably, looked the same at both ends of the machine, and continuous flexible mica insulation was used. The use of the best materials at the lowest stresses tended to the production of long rotors with small diameters. His lantern slides included views of water-cooled and closed circuit air-cooled generators and several illustrations of the 30,000-kW Rotherham alternator, in connection with which the speaker remarked that a double set of h.p. and neutral terminals had been brought out of the machine to enable it to be furnished with balanced protection similar to that provided for cables.

Mr. J. Rosen, in replying to the discussion, advocated "safety first," which precluded the use of high peripheral speeds. A fan pressure of 4 in. was sufficient to expel the cooling air and the fan motors were just as reliable as the alternators themselves. Reliable high-pressure generators could be produced if they were demanded, but he did not think station engineers were prepared to pioneer in that direction at present.

THE BRITISH INDUSTRIES FAIR.

LONDON AND BIRMINGHAM.

London Section.

It has already been stated that the White City section of the Fair, the ninth of the series, is confined mainly to light goods, such as leather, printing and stationery, pottery, fancy goods, &c., which make a fine display, although there is little of electrical interest on view.

Mr. A. Dunhill's novel exhibit of special interest to women is a handbag, so constructed that on opening the clasp a small electric lamp is lighted in the bag. Ladies who have groped blindly in the dark corners of their handbags for an elusive key or stray ticket will appreciate the usefulness of this new "gadget."

Messrs. H. Wolff & Co. have a large variety of lamp shades in linen, silks, chintzes, and paper on view, while

Messrs. Livermore & Knight, Ltd., are showing the "Mystery" revolving lamp shades, and

Messrs. S. L. Miller & Co. specialise in hand-painted shades to match vases adapted for use as table lamps.

Mr. G. C. Aimer shows X-ray tubes and parts, as well as high-frequency electrodes and apparatus.

Messrs. Hopkin & Williams, Ltd., amongst their chemical exhibits have on view radio-active substances and barium sulphate for X-ray diagnosis.

The stand of the Ever-Ready Co., Ltd., is the only "all electric" one in the show; on it are displayed a large variety of portable electric lamps, in addition to many dry cells and batteries.

The Federation of British Music Industries has co-operated with the Department of Overseas Trade in making the musical instruments section of the Fair a representative one. The Waveola (Gramo Depôt) amplifiers for gramophones and radio apparatus are of interest, and the development of the application of electric power to gramophones is shown on the stand of Electric Gramophones, Ltd., whose "Unit" electric drive is designed to give constant driving torque on all voltages over 50, by using a motor wound for low pressure only, and absorbing excess voltage by means of an "Osram" lamp which, acting as a buffer, compensates for every rise or fall in pressure. The commutator with its graphite brushes runs sparklessly, while the lamp which acts as the resistance is never subjected to the full voltage for which it is designed, and, if the gramophone is taken to another district, it is merely necessary to change the lamp for one of the new voltage.

Amongst other products the Horstmann Gear Co., Ltd., is exhibiting a range of "Newbridge" electric time switches for shop window and street lighting purposes, including a new model. The Synchronome Co., Ltd., shows a range of electric clocks and circuits for electrical impulse dials, while Messrs. Gillett & Johnston have on view standard silent master clocks and secondary movements, similar to the installation of 700 which was supplied to the County Hall, London, and, in addition, they are making a feature of an exhibit of the new quarter chiming tower clock for the Royal Exchange, London. This clock is operated entirely by electric motors, and is automatic in action, obviating the necessity of weights, and the consequent waste of space and expense in arranging for these. It combines the advantages of the well-known tower clock mechanism with small electric motors, which take the place of the weights. The firm has just shipped an unusually large electrically-wound clock to Montreal, where it is now giving the time to the shipping from the Harbour Memorial Tower.

As was the case last year, several stands are occupied by kinematograph apparatus and accessories of all descriptions, amongst the exhibitors of this class of goods being Cinema Traders, Ltd., Will Day, Ltd., Jury's Imperial Pictures, Ltd., Ernest F. Moy, Ltd., Omnia Kine Apparatus Co., Ltd., Ross, Ltd., and W. Vinten.

The Listophone Wireless Co. shows a receiver and "loud speaker," and Glimpsograph, Ltd., has an automatic advertising picture machine.

Last, but by no means least, Messrs. Needham Bros., amongst other things, exhibited portable electric water fountains suitable for dinner table decorative purposes, &c., which raise and throw their own water so long as the motive power is available.

Birmingham Section.

Automatic and Electric Furnaces, Ltd., exhibits four examples of its furnaces for the heat-treatment of steel. These are all of the "Wild-Barfield" pattern, consisting of a refractory chamber surrounded by a closely-wound helix of wire, in which is placed a controlling resistance. The furnaces are not only simply constructed, but control is an easy matter. All the examples shown are equipped with magnetic detector windings and patent excess-temperature cut-outs. The former is an outer winding superimposed on the heating coil and connected to an indicator designed to give a visual signal to the operator of the furnace. This indicating device shows when the non-magnetic point of the charge has been reached, which is the stage at which it must be quenched to obtain the best results. The excess temperature cut-out consists of a wire loop in the heating-current circuit, entering the furnace for a short distance. When the temperature becomes excessive the loop is fused, automatically cutting off the current. At the same time, a small pilot lamp is illuminated, drawing the operator's attention to the furnace. As a pyrometer is also used, the cut-out really acts as an emergency device in case of neglect.

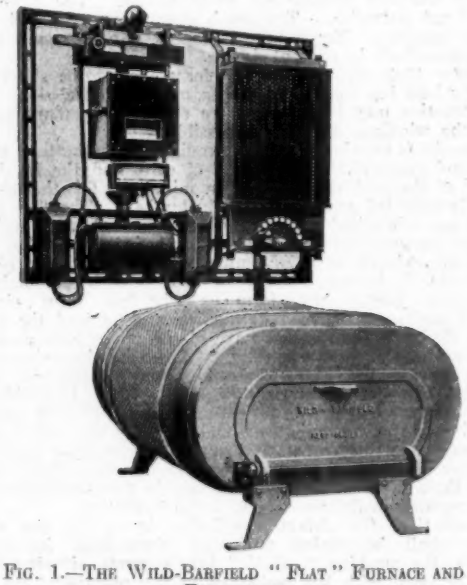


Fig. 1.—The Wild-Barfield "Flat" Furnace and Equipment.

The flat type of furnace (illustrated in fig. 1), examples of

which appear on the company's stand, is made in six sizes for hardening from 5 to 70 lb. of steel per hour (from .9 to 9.5 kW). The charge is placed on a tray of nickel chromium or nickel. The examples shown and demonstrated are the 4.2-kW and 9.5-kW sizes. The heating chamber of the former is 17 in. long, 11 in. wide, and 4 in. high, and it can harden 30 lb. of steel parts per hour. The other has a chamber 23 in. long, 16½ in. wide, and 6 in. high, and has a capacity of 70 lb. of steel parts per hour. As will be seen from the illustration, the equipment consists, in addition to the magnetic indicator and excess-temperature cut-out, of a control board bearing the pyrometer, controlling resistance, ironclad switch and fuses, &c.

The other two furnaces exhibited are of the vertical pattern, a type made in 14 sizes capable of dealing with from 5 to 100 lb. of steel hourly (.9 to 12.6 kW). Those shown are the 5.6-kW size for the treatment of 40 lb. of steel per hour, with a cylindrical heating chamber 8 in. in diameter and 25 in. deep; and the 9.5-kW size, capable of hardening 70 lb. per hour, with a chamber 12 in. in diameter and 23 in. deep.

Messrs. Newton Bros. (Derby), Ltd., exhibit examples of electrical machinery, including d.c. generators for radio communication. One of these is a duplicate of the machine used by the R. 34 during its cross-Atlantic flight, when communication was maintained with shore stations the whole time. It has an output of 160 W at 1,200 V, and weighs only 11½ lb. Another type of generator for use on aircraft is shown. This has an output of 150 W at 1,500 V, and there is also a subsidiary l.p. supply for valve filaments. A rotary transformer which is exhibited has an output of 80 W at 1,200 V and weighs 8¼ lb. All these machines give an unvarying potential under load; they are free from commutator and slot ripples; and the potential is under instantaneous control. A number of a.c. motors is displayed. These are of strong construction and easily adapted to enclosed or semi-enclosed operation. The feature of greatest interest, however, is probably the patent reversing drive. The drive shown is an improvement upon that which the firm has had on the market for 15 years, in that it does away with the reversing motor and magnetic reversing clutches. It was found that the former method of reversal, although satisfactory in operation, was extravagant in power consumption, and although regeneration might have been resorted to, the complications involved in the switchgear, &c., rendered it commercially impracticable. Very serious inertia effects have to be dealt with in connection with the employment of the heavy masses incorporated in the reversing-motor type of drive. These and other disadvantages led to the adoption of magnetic reversing clutches. This showed a great advantage over the earlier system by effecting a considerable saving of power. A further advantage was that due to the use of a single motor drive as against the reversing motor drive. Further research, however, resulted in the production of a purely mechanical reversing drive, the "Newton Patent Planer Drive." In this the driving motor is kept rotating in the same direction all the time, the reverse

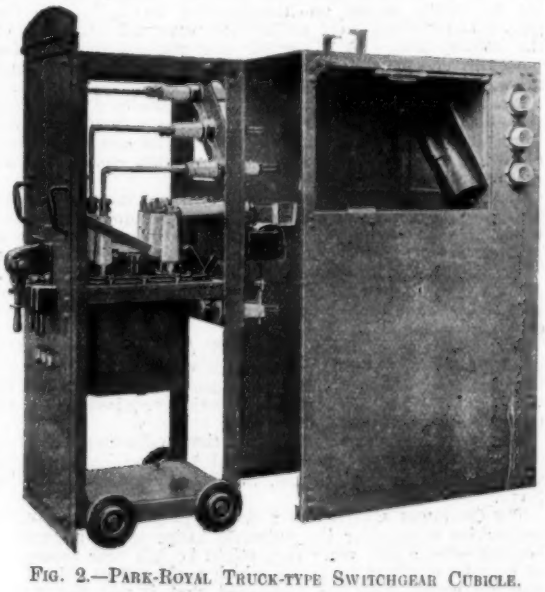


Fig. 2.—Park-Royal Truck-type Switchgear Cubicle.

motion being actuated by the release and application of magnetic brakes at the end of the travel, enabling gear wheels to fall into mesh and rotate the shaft of the driven machine in the opposite direction.

The Park Royal Engineering Works, Ltd., has as its principal exhibit a truck-type cubicle of the latest design, with patent protective gear, suitable for use on a 6,600-V, 3-phase circuit. This equipment is illustrated in fig. 2. The contacts are self-aligning, and those on the "live" side are automatically covered by insulating shutters when the truck portion is withdrawn. The oil switch embodied in the gear has a throw of 180 deg., which greatly facilitates operation. Air buffers on the switch prevent jarring, and there is a mechanical indicator in the front which shows the position of the switch. Time-limit fuses are fitted. On the stand an oil switch is shown separately, and, in addition to this, there are examples of the firm's circuit breakers made to B.E.S.A. specifications, and having a positive closed position preventing the breaker from being shaken out by vibration. There are also samples of knife-switches, self-aligning cut-outs, measuring instruments, &c.

Messrs. J. H. Tucker & Co., Ltd., again have a varied display of their products, chief among which are switches of many patterns. A range of ironclad switches with quick break only and with quick make and quick break. In these the coupling bars are of mica-covered steel, and are not affected by damp and other mischievous agencies. These switches are made in 15- and 30-A sizes for two, three, or four poles, and in 60-A size double and triple-pole. Combined switches and fuses are shown. A large collection of tumbler switches and switch plates is present, including the firm's new quick-make and quick-break flat tumbler switch of improved design, in which an encased compression spring gives a direct positive drive throughout the stroke, the arcing partition is of generous dimensions, and terminal screws and dead parts are remote from arcing points. Among special designs of tumbler switches are series-parallel and two-pole patterns. A range of battery-charging switchboards is shown, as well as a number of iron- and teak-cased distribution boards for domestic and commercial use. For the rest, the display consists of lampholders, ceiling roses, adaptors, plugs and sockets, and other small accessories.

Edison Accumulators, Ltd., which occupies a portion of the space allotted to Nobel Industries, Ltd., shows a complete range of "all-steel" accumulators varying in capacity between 1.5 and 450 Ah. In these accumulators the positive plates are composed of helical tubes of finely-perforated nickeled-steel strip, with alternately arranged thin layers of nickel hydroxide and fine metallic nickel flake. Each tube is about 4 in. long and ¼ in. in diameter, and contains over three hundred such highly-compressed double layers. Each tube is strengthened by eight solid steel rings, evenly spaced. The frames are of light punched nickeled steel. The negative plates are also an assemblage of small units, but in this case of oblong pocket form. The pockets are filled with specially-prepared iron oxide, incorporated with a trace of mercury to improve conduction. The container is of tough nickeled cold-rolled sheet steel welded at the seams. The sides are corrugated to ensure the maximum mechanical stiffness. The plates are insulated from one another and from the container by hard rubber strips and racks. The Edison cell has a very large energy-storing capacity per unit weight. Even in the 40-Ah cell this is about 11 Wh per lb., and in the larger sizes it rises to 15 or 17 Wh per lb.

Venner Time Switches, Ltd., shows a complete range of time switches capable of dealing with currents of from 1.5 to 400 A, single-, double-, and triple-pole, for all voltages up to 2,500. The clocks are made for 1, 14, or 45-day operation, and the apparatus is contained in wooden, cast-iron, and cast aluminium boxes. Among the different types exhibited are street-lighting switches for dealing with single lights or groups, contained in weatherproof boxes. The shop-window switches range from a simple one-day mechanism to a more complicated arrangement which operates at different times on different nights, and is out of action on Sundays. There is also a staircase switch for blocks of flats, which is operated at the door of each flat, and at the main entrance by push buttons. It is so designed that anyone going out or entering after the lights are extinguished for the night can press the nearest button, when the lights on each landing remain "on" for a short time, and are then extinguished automatically. A switch for wireless telephony automatically prevents the reception of unwanted signals while ensuring that time signals are not missed through neglect to switch in at the right time. For large currents and high voltages clockwork mechanism is adapted to oil-break switches. Two types are shown—one similar to a loose-handle circuit breaker, with the clock taking the place of the overload coil; and the other switched on and off automatically by the clock. A special system for giving a graduated intensity of light in chicken runs, to increase egg-laying, is also demonstrated. One type of time-switch exhibited is adaptable to programmes at works, to actuate warning signals at starting and stopping times. Two types of current limiter are shown—simple "blinkers" and limiters fitted with excess-current cut-outs, which switch off the current altogether. In the latter the circuit can be re-established by the depression of a sort of button projecting from the case. In addition to the foregoing, the firm exhibits samples of its aluminium castings for various purposes.

(*To be continued.*)

"Underground" Progress.—The "Underground" Companies have issued a poster containing a view of the extension work at Hendon, on the Edgware and Hampstead section of the London Electric Railway. The extension is to be put into operation this year.

ELECTRIC POWER IN THE HOME.

The paper read at the salesmanship meeting of the Electrical Development Association on Friday, February 16th, was one on electric power in the home, dealing particularly with motor-driven appliances and methods of selling them. The paper was by Mr. J. W. Beauchamp (Director of the E.D.A.), who prepared it at very short notice, owing to the fact that Mr. L. J. E. Genner, of the Western Electric Co., who should have lectured on this subject, was unable to attend. Mr. A. C. Cramb, borough electrical engineer, Croydon, and Hon. Secretary of the I.M.E.A., presided.

Mr. Beauchamp, dealing with the advantages peculiar to the selling of motor-driven appliances for the home, pointed out that the salesman had not to meet competition with gas, and was offering a facility which could be obtained in no other way. Again, although some of the appliances were relatively expensive to buy, the amount of energy they consumed in a year was small, so that the price of electrical energy was not so vital as in the case of cooking and heating. In support of his contention that the argument that this small motor load did not bring sufficient revenue to the supply undertaking to justify its encouragement was unsound, he said that if a moderate load was built up on lighting rates it was very profitable, and seldom produced mains problems; if the supplier was unable to offer a rate low enough for heating and cooking he might yet secure much additional business with small appliances at fairly high figures, say, up to 3d. or 4d. per unit. In any case, electric power in the home was an excellent ambassador for other and greater revenue-producing uses.

Discussing the leading appliances of this nature, Mr. Beauchamp dealt with the fan first, and pointed out that each year they were all invariably late with their orders, stock, and advertising. He referred to the principal advantages of fans, and advised salesmen not to sell them unecessarily large for the work in view, because people wanted moving air and not a dust storm, or any more buzz than necessary. Costs should be spoken of relatively; for instance, the cost of ample air circulation was no more than the cost of burning one or two lamps. The Americans had sought for means of selling fans in winter, with some success, using them for circulating the warmth from hot-water radiators, keeping vapour off windows, &c.

He also dealt with the sewing-machine motor and the suction cleaner; the latter should offer great business. In order to sell it one should compare it with sweeping, particularly knee work with a stiff hard broom—which was not so much dirt removal as dirt distribution. One should also stress the amount of wear of carpets cleaned by means of rotary sweepers and hand-brooms, compare it with the wear of those cleaned by the suction cleaner, and put forward the health argument in relation to the need for clean floors where there were young children. He had wondered that the great suction-cleaner advertisers had not used the baby as a salesman, and he presented them with this idea for a good poster.

With regard to the washing machine, which was relatively expensive, he suggested that the story of the salesmen of this machine should centre chiefly around the saving as compared with laundry charges, and health. It had been stated that each penny expended on energy and cleaning materials in the electric washer would cover 1s. worth of work at ordinary laundry rates, and further, risk of infection could be avoided by cleaning clothes at home and yet escaping most of the heavy work. Other applications of electric power included the plate-washer, polishing machine or buff, wisks, mincers, &c., and he had little doubt that business in them would develop behind the more popular lines above referred to.

Dealing with this class of apparatus generally, Mr. Beauchamp advised salesmen not to worry too much about first cost, but to get a suitable story ready which would meet the particular conditions. He also emphasised the importance of selling as many outlets in a wiring installation as was reasonable because outlets to-day would sell appliances to-morrow. The lack of these was a great deterrent to the use of appliances. They should push the B.E.S.A. standard plugs and fittings, making it easier for a consumer to add equipment piece by piece, and less likely for him to be strangled in a maze of flexibles. Advising that the normal electric light bill in a home should be used as a sort of datum line by salesmen, he said that in a middle-class house using 300 kWh per annum at 8d. per unit for lighting, the bill would amount to £10, and 300 units for other purposes at 2d. would be £2 10s., so there would be six extra units a week available for a 25 per cent. increase in the bill, and these six units would probably cover the full use of a suction cleaner, washing machine, flat-iron, fan, and sewing machine.

The Chairman, after emphasising the need for more outlets, said that the initial cost of washing machines, vacuum cleaners, &c., was heavy compared with the electricity sold, and supply authorities felt that the man who sold the apparatus ought to do the main part of the work of developing this part of the industry. Supply authorities and contractors were not working together in a manner which would produce the best results. The electrical Press had done its very best to bring before both the supply undertaking and the contractor the necessity of putting their backs into this business, and, of course, Mr. Beauchamp had done wonderful service. It was time they stopped blaming each other, and got down to co-operative effort; if they did not make up their minds to do that there should be some force to make them.

Mr. C. G. Nobbs pointed out markets for heavy-priced machines. Country houses with their own plant liked these small current-consuming devices, and were accustomed to doing the work for themselves because of the distance they often had to send to get it done for them. There was a tremendous field for small motors in dairies and farms, as well as for refrigerators.

Mr. Bostel (Croydon Corporation Electricity Department), suggested charging a small fixed rate to include both lighting and power, in order to develop this business, which did away with the trouble of getting people to wire for power outlets. Manufacturers were doing a great deal in pushing business in suction cleaners, and contractors reaped greater benefit from the sale of such apparatus than the supply authorities. The vacuum cleaner, he believed, would only consume one unit in 8 hours. He emphasised the point that supply authorities, even though not allowed to sell the apparatus, should try to create interest, and this was the policy adopted at Croydon.

Mr. A. Gowans Whyte ("Electrical Industries"), said that the Americans started advertising their fans in January. A dish-washer seemed to be one of the most difficult of electrical motor-driven appliances to sell. He had had one on trial, and his experience was that the amount of trouble involved in using it was greater than the trouble of washing dishes in the ordinary way. His feeling was that American machines were made to suit American conditions, and it would be well to consider the problem afresh from the point of view of the ordinary British scullery, which was not fitted out so well as the American kitchen-scullery. Supply authorities and sellers of apparatus should give some attention to the working of the machines at intervals.

Mr. Morton (Sun Electrical Co.) said he did not think the benefit to be gained by efficient service was sufficiently appreciated. With regard to the high cost of washing machines, his own company had machines at £29 15s., £39 10s., £45 and £50, and the machine which sold most rapidly was the £50 model. The next best was the £45 model, and the two cheaper ones were very far behind. One had a big pull when selling on hire-purchase terms, because the periodical payments were usually less than the actual cost of the laundry bills. A 3d. or 4d. rate was not necessary for power-driven appliances; he had been paying 8d. per unit, and his washing machine cost about 2d. per week at that price.

Mr. Lower (Norwich Corporation Electricity Department) said that the people who really wanted electrical apparatus were those without servants, and a hire-purchase system was needed. A maintenance scheme for vacuum cleaner motors was essential.

Mr. King (Ilford) said that if they hired out vacuum cleaners, assuming they cost £10 each, the charge per quarter must be fairly high unless the undertaking was to subsidise it to a greater extent than it should. They proposed to put a 12-point lighting installation on hire at a rental of 7s. 6d. per quarter; if they put plugs in, they would have to double that rental, and would probably not get the business they otherwise would do.

Mr. F. Pooley (Messrs. Pooley & Austin) suggested the development of a small motor which would have a more or less universal use in a house, and could be moved about to work various apparatus, many of which required the same speed and power.

Mr. Scott (Admiralty) suggested the application of electric motors to mangles and wringers, small bread-mixing machines, and potato peelers, which last, were used a great deal in the Navy.

The Chairman said it was a serious proposition for supply authorities to consider the universal hiring-out of apparatus, because after a few years they might be left with thousands of pounds' worth of apparatus which could not be got rid of, and his undertaking had concluded that it was not sound business to take it on. It was difficult to make the public understand the advantages of a multi-part tariff.

Mr. Beauchamp, replying to the discussion, suggested turning the scullery into a sort of workshop, having a little motor and perhaps a countershaft. He did not agree with cutting the price of the unit down to the lowest possible limit; he wanted electricity to be cheap, but did not want it to be given away. If a small profit were made at 1d. per unit, there was no need to reduce it to ½d.; it was better to spend the money on giving better service, advertising, &c.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR JANUARY, 1923.

The Board of Trade returns of electrical export and import business for the first month of 1923 show considerably higher values in all sections as compared with December, 1922, the electrical export figures totalling £1,196,090, as compared with £901,309 for December, an increase of £294,781, the principal increases occurring in "Other motors and generators," £117,640 increase, and telegraph and telegraph instrument and apparatus, £88,909 increase, whilst higher values were also recorded in nearly all the other sections, the only items showing a falling off being meters and electrical instruments and railway and tramway motors; as compared with January, 1922, the electrical export totals are £173,383 down; the table below will show at a glance the sections in which the differences occur.

The total weight of electrical machinery exported during January, 1923, was 1,988 tons, as compared with 1,958 in January of the previous year.

Electrical imports for the month at £284,102 were £21,468 higher in value than in December and £125,521 more than in January, 1922.

The re-export figures of electrical goods and machinery for January were £3,373 more than in the previous month and £4,741 higher than in January, 1922.

Values of Electrical Exports and Imports for January, 1923, with Comparisons with the Previous Month and with January, 1922.

	Exports.			Imports.			Re-Exports.		
	Jan., 1923.	As compared with the previous month (Dec., 1922).	As compared with Jan., 1922.	Jan., 1923.	As compared with the previous month (Dec., 1922).	As compared with Jan., 1922.	Jan., 1923.	As compared with the previous month (Dec., 1922).	As compared with Jan., 1922.
Electrical goods and apparatus (unenumerated).	£127,089	+ 25,867	+ 4,169	£62,466	−10,081	+ 12,266	£7,314	+ 3,762	+ 2,792
Insulated wires and cables	204,616	+ 18,471	+ 24,530	23,968	− 2,369	+ 15,828	1,199	+ 1,154	+ 764
Glow lamps	29,032	+ 7,286	+ 22	24,144	−16,095	+ 5,108	141	− 339	+ 48
Arc lamps and parts	530	+ 140	− 958	2,561	+ 1,739	+ 1,994	370	+ 370	+ 300
Batteries and accumulators	47,355	+ 6,846	+ 13,961	12,270	− 4,518	+ 8,620	5	− 170	+ 5
Meters and instruments	25,634	− 4,957	− 10,832	10,177	+ 3,445	+ 4,344	2,550	+ 2,271	+ 2,518
Carbons	6,670	+ 5,564	− 73	4,207	− 4,396	+ 1,560	125	− 119	− 750
Electrical machinery—									
Electrical machinery (unenumerated)	164,022	+ 1,748	− 42,865	110,976	+52,900	+ 64,105	5,761	− 4,024	+ 2,647
Railway and tramway motors... ...	16,821	− 11,435	+ 943	—	—	—	—	—	—
Other motors and generators	254,059	+117,640	− 90,440	—	—	—	—	—	—
Switchboards (not teleg. or telep.) ...	15,508	+ 7,906	− 70,467	80	− 175	− 865	1,186	+ 1,186	+ 1,114
Telegraph and telephone cable and material—									
Telegraph and telephone wires and cables (not submarine).	54,909	+ 19,271	− 26,754	8,393	+ 1,368	+ 4,896	30	+ 30	+ 30
Submarine teleg. and telep. cable ...	75,121	+ 11,525	+ 71,728	—	—	—	4	+ 4	+ 4
Telegraph and telephone instruments and apparatus.	174,724	+ 88,909	− 46,347	24,860	− 350	+ 7,665	1,335	− 752	− 4,731
	£1,196,090	+294,781	−173,383	£284,102	+21,468	+125,521	£20,020	+ 3,373	+ 4,741

PARLIAMENTARY NOTES.

[By Our Special Parliamentary Reporter.]

Relief for the Unemployed.—On February 15th, during a debate on unemployment, Sir M. Barlow, the Minister of Labour, said that the Office of Works proposed to allocate £400,000 for arrears of maintenance and repair work, and the Post Office was bringing forward rapidly schemes for the laying of cables, representing an expenditure of about £1,000,000. Under the Export Credits scheme to date credits up to £24,250,000 had been sanctioned, and £2,250,000 of this had been sanctioned since November last. As to the Trade Facilities Act, large schemes had been recently submitted to the Committee, and some of them, he hoped, would be in operation very shortly. For example, there was the proposal in connection with the ship-building industry, which alone would involve £2,509,000 of expenditure. There was also before the Committee a projected £8,000,000 loan for further extensions of the "Underground" system.

Radio-Telephony for Country Dwellers.—On February 14th, Sir D. Newton called attention to the position of the rural dweller with regard to radio-telephony. He said that they were told the rural people were not going to be allowed to have receiving sets if they served a large number of people, but they would have to pay for a special licence. That was hampering the development of this new service. He also urged that telephones should be installed at country railway stations and that light railways should be developed.

Merchandise Marks Bill.—On February 15th, Sir J. Hood asked the President of the Board of Trade whether he proposed to introduce the Merchandise Marks Bill at an early date.

Sir W. Joynson-Hicks said he was at present engaged in considering a number of questions in connection with the Merchandise Marks Bill, and could not yet say when it would be ready.

Clyde-Forth Canal.—On February 15th, Mr. Morel asked the Prime Minister whether his attention had been drawn to the national and commercial advantages which would ensue from the construction of a canal from the Clyde to the Forth; and whether, in view of those advantages and of the necessity of providing work for the unemployed, he would give early and favourable consideration to the project.

Col. Ashley, who replied, said that the attention of the Government had been drawn to this project, but the Prime Minister had already stated that the large expenditure involved was not considered to be justified at the present time, and he was advised that commercially the proposed canal would not pay its way.

Mr. Bonar Law stated that inquiries into this matter were proceeding, and in any case he did not think that legislation was practicable this session.

Finsbury Tube Extension.—On February 15th, Major Malone asked the Parliamentary Secretary to the Ministry of Transport whether he had yet interviewed the directors of the Great Northern Railway Co. on the subject of the tube extension from Finsbury Park, as promised to the deputation, representing Tottenham, Edmonton, Enfield, Hornsey, and Wood Green, received by him in November last; and whether, in view of the great amount of unemployment in those districts, he would use his powers to facilitate this most necessary work as soon as possible.

Mr. R. Morrison asked the Parliamentary Secretary whether he was aware that the Metropolitan Railway Co. was prepared to consider favourably the immediate construction of a tube railway northwards from Finsbury Park, but was prevented from doing so by the Great Northern Railway (No. 2) Act, 1902, Clause 36, paragraph 13; and whether he would make representations to the London & North-Eastern Railway Co. to sanction this work or, alternatively, whether he would advise the Government to amend the Act.

Col. Ashley, in reply, said he had ascertained that the Metropolitan Railway Co. was considering whether any tube railway extensions could advantageously be constructed northwards from Finsbury Park. No powers to construct such lines at present existed, and the preparation of any scheme for submission to Parliament would necessarily take a considerable time.

Private Bills.—The following private Bills have been presented and read a first time in the House of Commons:—

The City & South London Railway Bill ("for empowering the City & South London Railway Co. to extend their railway and to confer further financial and other powers on the company, and to confer powers on the London Electric Railway Co., the Metropolitan District Railway Co., the Central London Railway Co., and the Wimbledon & Sutton Railway Co."); the London Electric Railway Bill ("to empower the London Electric Railway Co. to construct new railways, subways and works, to raise additional capital, to confer further powers on that company and on the Metropolitan District, Central London, City & South London, and Wimbledon and Sutton Railway Companies"); the Maidstone Corporation Bill ("to empower the Mayor, Aldermen and Burgesses of

the Borough of Maidstone to provide and work trolley vehicles and omnibuses, to make further provision with regard to the light railways, electricity, markets, baths and other undertakings of the Corporation "); the Metropolitan Railway (Various Powers) Bill (" to authorise the Metropolitan Railway Co to borrow moneys "); the Potteries & North Staffordshire Tramways & Light Railways Bill (" to make provisions with reference to the undertakings of the Potteries Electric Traction Co., Ltd., and the North Staffordshire Tramways Co., Ltd., and to confer powers upon those companies "); the Rugby Urban District Council Bill (" to empower the Urban District Council of Rugby to construct additional waterworks and to make further provision in regard to the water and electricity undertakings of the Council "); the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board Bill (" to confer further powers on the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board "); the Torquay Corporation Bill (" to confer further powers upon the Corporation of Torquay with regard to the health, local Government and improvement of the borough and with regard to their water, electricity and gas undertakings "); and the Rating of Machinery Bill (" to amend the law relating to the rating of hereditaments containing machinery ").

LEGAL.

British Thomson-Houston Co., Ltd., v. Leicester Electrical Engineering Co.

THIS motion, against defendant company and two directors, adjourned from February 9th, for an injunction restraining the infringement of the plaintiffs' patent for leading-in wires for electric incandescent lamps, was again before Mr. Justice Romer in the Chancery Division on February 13th.

The defendants, by their counsel, submitted to judgment against them in the usual form, an inquiry as to damages, delivery up of the infringing articles, and costs.

In the Chancery Division on February 16th, before Mr. Justice Sargant, the British Thomson-Houston Co., Ltd., moved for an injunction to restrain infringement of letters patent. Mr. Trevor Watson, for the plaintiffs, said the defendants were willing to treat the motion as the trial of the action, and there would be the usual order in terms of the motion, and an injunction, an inquiry as to damages, and delivery up of the infringing articles, and costs as between solicitor and client because the validity of the patent had been upheld.

City of London Electric Lighting Co., Ltd., v. West Indies and South American Finance Co., Ltd.

IN the Mayor's and City of London Court on February 15th, before Judge Shewell Cooper, a claim was made by the plaintiff company against the defendants, of 8, Laurence Pountney Hill, E.C., for £17 17s. 2d. for electrical energy supplied and for expenses of disconnecting. Plaintiffs' chief collector said they had given a supply to the defendants over a period of six months, and upon the account being rendered in the usual way in July it was accepted by the defendant company and no question was raised until September, when the defendants' managing director attended at the office of the plaintiff company and questioned the accuracy of the meter. It was pointed out that the defendants had their remedy by applying to the inspector at the Guildhall. The company proposed that its own engineer should test the meter, and the defendants' managing director agreed to abide by his decision. A test took place, and the final readings of the meter agreed with the amount now charged.

MR. D. M. WALKER said he was managing director of the defendant company. On March 27th certain electric stoves were put into the offices, and they started using current for them. For the June quarter a bill was sent in for £16 1s. for heating. The plaintiffs' man who came previously to read the meter expressed surprise at the amount of current used, and he (witness) was on the look-out to tackle the plaintiffs on the point. When the bill was sent in, he spoke to the plaintiffs on the 'phone about it. He had explained to the plaintiffs' collector that there were only two out of four stoves in use from March to June, which were practically summer months, and the stoves were used very economically, because it was a first trial as an experiment. He was told that the current used was too much under any circumstances. The makers of the stoves had been questioned, and had said that they must be out of order to have used such an amount of current. He had asked the plaintiffs to allow the stoves to be used for the same period during the present year, and they would pay the amount of the account for lighting. The current, however, was cut off and the meter taken away, and defendants refused to pay.

Judge SHEWELL COOPER said the defendants had agreed to abide by the decision of the engineer of the plaintiff company, and that had been given. The witness complained that the decision was not given him at the time it was made, but was told the matter had to go through some process at the office, so whether the decision was true or not he (witness) could not say. The Judge said in the face of the decision the defendants would have to pay, and gave judgment for the plaintiffs for the amount claimed, with costs.

Z Electric Lamp and Supplies Co., Ltd.

IN the Chancery Division, on February 16th, Mr. Justice Astbury sanctioned the reduction of the capital of this company. Mr. Hodge, for the company, said the reduction was of a simple character. It was a case where one shareholder was surrendering 4,000 fully-paid shares, to make up loss sustained by the company. The surrender had been made but it could not be effective without his Lordship's order.

Robinson v. Leatherhead and District Electricity Co., Ltd.

IN the King's Bench Division, on Monday, Mrs. Jane Anne Robinson, Percy Robinson and Joseph Frank Robinson, upholsterers, of 1, The Crescent, Church Road, Leatherhead, sued the Leatherhead & District Electricity Co., Ltd., for damages arising out of a fire which took place on the plaintiffs' premises on February 22nd, 1922, through the alleged negligence of the defendants, who denied liability. Mr. F. Van den Berg appeared for plaintiffs and Mr. H. H. Trusted for defendants.

Plaintiffs' case was that the fire broke out in their workroom about 3.15 a.m. Just over ten years ago the defendants installed the electric light on the premises, linking up the main cable in the usual way with a branch cable. The wires ran up the centre of the wall and their only protection was a thin leaden casing; it was now alleged that the fire was caused by the fusing of the wires. After the installation, about ten years ago, the electric lighting was no longer required and the defendants were instructed to disconnect it. This was done, but in such a way that a live wire was still left and was a menace to the property.

Mr. PERCY ROBINSON, one of the plaintiffs, stated that he had already been paid for the damage by the underwriters, who were now maintaining the present action.

In cross-examination, witness said there was a gas light in the workroom and a gas stove. He admitted he was a cigarette smoker.

Mr. RADFORD, an expert electrical engineer, stated that the fire was caused by electricity, the wiring not being sufficiently protected. The leaden covering had been injured in such a way as to lead to the fusing; the cables were not properly protected.

Mr. H. BARNES, consulting engineer and partner in A. T. Snell & Partners, gave similar evidence.

For the defendants, it was stated that the cable was left in, as was usual after the disconnection, because it would facilitate re-installation.

Evidence to this effect was given by the resident engineer of the company, Mr. George Horner, and his Lordship held that plaintiffs were entitled to recover and gave judgment for them, with costs.

Workmen's Compensation Claim.

IN the Mayor's and City of London Court, on Monday, before Judge Shewell Cooper, Thomas P. Everington, labourer, North Woolwich, made a claim under the Workmen's Compensation Act against W. T. Henley's Telegraph Works Co., Ltd., to recover compensation for injuries that befell him on January 24th of last year at their premises, when he severely sprained his right knee. He had had 35s. from the date of the accident until October 24th and his present claim was for a continuation of the payments. Defendants agreed to pay £75 damages in full discharge of their liability and 15 guineas costs, which plaintiff accepted. The Court approved.

Bath Artcraft, Ltd., v. Messers, Ltd.

IN the Mayor's and City of London Court, on Monday, before the Recorder (Sir E. Wild, K.C.), plaintiffs, cabinet makers and joiners, of Bath, claimed £75 against defendants, of 61, Gracechurch Street, E.C., for the balance of the price of a Kynoch gas-producing plant. Mr. Aggs appeared for the plaintiffs and Mr. R. J. Willis for the defendants. Defendants said that the plant was represented as being suitable for burning wood waste, sawdust and shavings. They found it was suitable for large wood only and not for the purpose of burning sawdust and wood shavings. Some small parts were missing. They rejected the plant and plaintiffs accepted the rejection and asked defendants to make an offer. They said they would try and sell the plant for the plaintiff, but they could not find a purchaser. They counterclaimed £30 18s. 3d., being the return of £10 paid as deposit and £20 18s. 3d. for carriage.

Mr. Aggs said that the plaintiffs wanted to set up an installation of electric power for their own works. The Bath Corporation, who owned the electricity works, asked the plaintiffs a price which they could not pay, and in order to counter that move and be free of the Corporation control in that respect they purchased from Parsloe & Co., who carried on business in Bristol, a Kynoch gas-producing plant with the idea of producing their own power. Having done that, the Bath Corporation, as might be expected, came to terms, with the result that all the equipment that the plaintiffs had supplied themselves with became useless. They put an advertisement in a trade journal offering to sell the Kynoch gas-producing plant. Defendants asked what the price was and whether it was capable of burning wood waste. Plaintiffs sold the plant to the defendants as they had had it delivered to themselves. Defendants sent down an engineer to examine the plant and offered £85, and the plant was sent under a sub-sale to a firm of timber merchants at Sevenoaks on defendants' behalf. Now defendants complained that it would not operate on sawdust only. There was, in truth, no plant in the world that would operate on sawdust only. Defendants also said that the machine would not operate at all.

Mr. Willis said that the bargain was quashed and there was an acceptance of the rejection. Defendants were under no liability to the plaintiffs. Plaintiffs had acquiesced in the rejection.

Mr. Aggs said that the defendants were not entitled to reject the plant.

The Recorder, after hearing the evidence, was satisfied that the defendants got what they bargained for. The machine was properly described to the defendants by plaintiffs' man, who explained how it would work. Had it been used as it ought to have been, it would have been in accordance with the contract; therefore he was against the defendants on that question, as he was on the rest of the case. Judgment for the plaintiffs on claim and counterclaim, with costs.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "U-Re-Lite" Circuit-breaker.

To eliminate the trouble and expense caused by the replacement of blown fuses, the Igranic Electrical Co., Ltd., 147, Queen Victoria Street, E.C.4, has introduced a small circuit breaker. Fig. 1 illustrates the external appearance of this device, and fig. 2 is a view with the cover removed. It is made in both double and triple-pole patterns. The former type is constructed for currents up to 200 A at all standard pressures up to 500 V. The triple-pole pattern is made for circuits up to 150 A per pole on 3-wire d.c. or 3-phase a.c. circuits for all standard pressures up to 250 V, and also for currents up to 80 A on 500 V, 3-phase circuits. The breaker can be positively set for a given current, and is contained in a lock-up steel box which prevents unauthorised interference. A loose-handle arrangement makes it impossible to hold the breaker in circuit against an excess current. One advantage of the "U-re-lite" device is that it can be used as a main switch at a slightly higher cost than that of a knife switch and the fuses which otherwise would be installed. It is possible to lock the breaker in the open position. The contactors are closed by turning the handle on the front first to the left and then to the right. The breaker is opened by pressing the knob in the centre of the handle. All sizes are fitted with either plain instantaneous overload trips or with time-lag trips. The larger sizes can be equipped also with a no-voltage release or shunt trip.

Fig. 1.—Exterior View of the "U-re-lite" Circuit-Breaker.

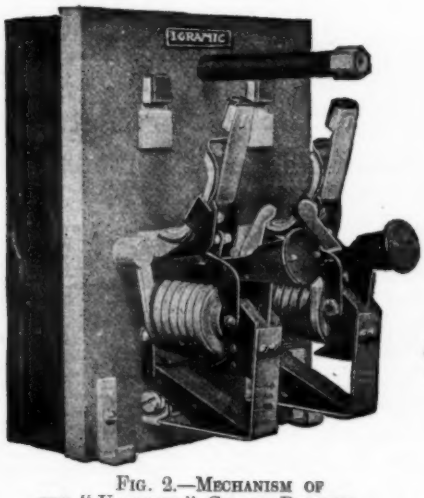


Fig. 2.—Mechanism of the "U-re-lite" Circuit-Breaker.

The Witton-Kramer Truck Crane.

Fig. 4 illustrates an electric truck crane recently developed by the Witton Works of the General Electric Co., Ltd., Magnet House, Kingsway, W.C.2. This is of the two-motor type, one motor being used to propel the crane and the other to operate the hoisting, slewing, and derricking motions; clutches are utilised to change over from one motion to another. The crane is capable of lifting a load of one ton at a radius of 10 ft. and at a speed of 20 ft. per minute. It slews at three r.p.m. and travels at four miles per hour. The arrangement is such that all motions, including travelling, can be operated from the driver's platform with the jib directly in the line of travel. Electric or mechanical brakes are fitted to all motions. The battery is built into the truck and is of sufficient capacity to supply the crane for six hours without recharging.

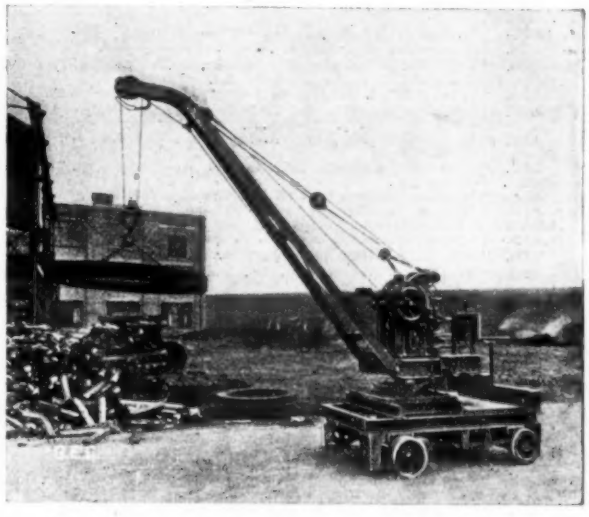


Fig. 4.—The Witton-Kramer Electric Truck Crane.

A New "Jackson" Fire.

The "Cheery" fire, illustrated in fig. 3, is the latest model produced by the The Jackson Electric Stove Co., Ltd., 143, Sloane Street, S.W.1. This fire has two 1.25-kW elements, and the heat is given out both directly and indirectly by means of an open front and a reflecting back. The fire is 20 in. in height, 12 in. wide, 12 in. deep, and weighs 12 lb. The horizontal plate above the elements enables the fire to be used for boiling liquids or for keeping food warm.

Fig. 3.—The "Cheery" Electric Fire.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Patent Agents, 285, High Holborn, London, W.C. 1.

3,011. "Sound boxes of sound-recording, telephonic, &c., instruments." M. A. Renison. February 1st.
3,026. "X-ray tubes." M. A. Codd and X-rays, Ltd. February 1st.
3,045. "Rotary mercury switches." Soc. C. Ropiquet, H. Hazart, et H. Roycourt. February 1st. (France, February 3rd, 1922.)
3,046. "Travelling wireless transmitting and receiving stations." L. M. Robinson. February 1st.
3,055. "Electricity meters." Electrical Apparatus Co., Ltd., and W. M. Mordey. February 1st.
3,062. "Means for carrying shades on electric lamp holders." J. T. Lewis. February 1st.
3,073. "Connections for flexible electric conductors." F. Pyman. February 1st.
3,074. "Electric switches." T. Brown and G. Ellison. February 1st.
3,088. "Driving of dynamos for motor-cycles, &c." F. I. Hoffman. February 2nd.
3,095. "Multiple electric signs." L. Ottorino. February 2nd.
3,100. "Microphones, &c." H. G. Wright. February 2nd.
3,106. "Valve holders for wireless telegraphy, &c." Beldam Tyre Co. (1920), Ltd., and R. S. Collis. February 2nd.
3,112. "Tram rail." J. A. Yeadon. February 2nd.
3,125. "Protective apparatus for high-voltage electric supply systems." Electric Control, Ltd., and J. E. Stewart. February 2nd.
3,132. "Electric wall plugs, &c." A. Reyrolle & Co., Ltd., and H. F. Secretan. February 2nd.
3,133. "Combined gramophone and wireless receiving system." E. A. Gordon. February 2nd.
3,135. "Illuminated signal." C. Keith. February 2nd.
3,147. "Horn or amplifier for sound-recording, &c., apparatus." G. Lakhovsky. February 2nd. (France, July 6th, 1922.)
3,148. "Dynamo-electric machines." J. E. Stewart. February 2nd.
3,158. "Wireless receiving apparatus." W. J. Oliver. February 2nd.
3,159. "Sound boxes for recording, &c., machines." W. E. Clifton and Cliftophone, Ltd. February 2nd.
3,166. "Methods of welding." British Thomson-Houston Co., Ltd. (General Electric Co.). February 2nd.
3,182. "Electrodes." C. H. Lauth. February 2nd.
3,183. "Insulated electric conductors." C. H. Lauth. February 2nd.
3,184. "Electric cooking ovens." C. H. Lauth. February 2nd.
3,208. "Production of high-tension uni-directional currents." H. E. Donnithorne. February 2nd.
3,209. "Renovation of vacuum tubes." A. Beltrami and R. Piras. February 2nd.
3,214. "Crystal detector for wireless instruments." T. F. Gaynor. February 2nd.
3,220. "Variable condenser." E. S. L. Beale. February 3rd.
3,230. "Electric condensers." J. H. Hewitt and Wilkins & Wright, Ltd. February 3rd.
3,234. "Wireless sets." H. W. Headland. February 3rd.
3,235. "Apparatus for audibly signalling periods of time." W. J. Geary. February 3rd.
3,242. "Tuning coils or inductances, &c." I. H. Parsons and H. R. Waddington. February 3rd.
3,254. "Wireless mast." C. B. Bathgate and C. Lever. February 3rd.
3,260. "Electric lights for buoys." F. W. Yeo. February 3rd.
3,262. "Sound-transmitting devices for telephones." M. G. Andersen. February 3rd. (Denmark, August 8th, 1922.)
3,264. "Train lighting, &c., dynamos." A. H. Darker, J. T. Prestige, and J. Stone & Co., Ltd. February 3rd.
3,267. "Devices for connecting and disconnecting electric circuits." A. E. White (Osterreichische Dynamo-Werke Akt. Ges.). February 3rd.
3,274. "Supporting means for aerials of wireless apparatus." D. G. Tanner. February 3rd.
3,287. "Advertising, &c., devices." Radiation, Ltd., and H. J. Yates. February 3rd.
3,288. "Tumbler electric switches." A. W. Butterfield and Mycromet Manufacturing Co. February 3rd.
3,293. "Electric switches." R. A. R. Bolton and English Electric Co., Ltd. February 3rd.
3,298. "Telephone systems." H. S. Conrad. February 3rd.
3,307. "Wireless aerial tuning condensers." G. A. Daubney and E. D. French. February 5th.
3,311. "Sparking plug." G. T. Hilton. February 5th.
3,312. "Electric power transmission." A. M. Taylor. February 5th.
3,333. "Means for varying angle of a beam of light from head-lamp, &c." T. H. Parry. February 5th.
3,335. "Multiple-contact panels for luminous signboards." E. Marre. February 5th. (France, February 4th, 1922.)
3,350. "Means for electrically igniting gas jets." A. G. Kent-Johnston. February 5th.
3,353. "Electronic valves." O. S. Puckle. February 5th.
3,368. "Variable resistances." E. R. Bartrum. February 5th.
3,379. "Multi-speed induction motors." L. J. Hunt and Sandycroft, Ltd. February 5th.
3,380. "Resonators for telephones, &c." F. J. Empson. February 5th.
3,389. "Starting alternating-current motors." British Thomson-Houston Co., Ltd. (General Electric Co.). February 5th.
3,390. "Fluid-flow meters, &c." British Thomson-Houston Co., Ltd. (General Electric Co.). February 5th.
3,414. "Lightning arresters." Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric and Manufacturing Co.). February 5th.
3,416. "Means for reproducing sound." H. J. Round. February 5th.
3,417. "Thermionic valve circuits." H. J. Round and P. W. Willans. February 5th.
3,426. "Electric inductances." T. Graham-Farish. February 5th.
3,427. "Electric switches." J. T. Keightley and Rotax (Motor Accessories), Ltd. February 5th.
3,430. "Cases for sparking plugs, &c." R. S. Grose. February 5th.
3,437. "Automatic, &c., telephone exchanges." G. H. Janson. February 5th. (Sweden, February 4th, 1922.)
3,438. "Anti-dazzle head-lights." H. J. Duffy. February 5th.
3,440. "Anti-dazzle lamps." G. A. Forrest. February 5th.
3,448. "Distributors for internal-combustion engines." A. Hammond. February 6th.
3,455. "Indirect lighting apparatus." P. Ross. February 6th.
3,457. "Signalling devices for tramcars, &c." R. Heaton. February 6th.
3,464. "Automatic, &c., telephone switching systems." W. Aitken. February 6th.
3,465. "Means of disconnecting undesired coils or circuits." P. A. McCarry. February 6th.
3,496. "Devices for adjustment of grid potential in thermionic apparatus." W. J. Ricketts. February 6th.
3,511. "Electric accumulators." T. Armitage. February 6th.
3,516. "Suspension of electric lines." G. Kjaer. February 6th. (Denmark, February 11th, 1922.)
3,525. "Electric discharge indicators." British Thomson-Houston Co., Ltd. February 6th. (United States, February 11th, 1922.)
3,527. "Device for rupturing electric arcs." Forges et Ateliers de Constructions Electriques de Jeumont. February 6th. (Belgium, February 28th, 1922.)
3,528. "Stators for dynamo-electric machines." Ateliers de Constructions Electriques de Charleroi Soc. Anon. February 6th. (Belgium, May 9th, 1922.)
3,540. "Magneto and plug tester." H. Hopkins. February 6th.
3,550. "Storage batteries." Gamewell Fire Alarm Telegraph Co. February 6th. (United States, April 15th, 1922.)
3,558. "Wireless telegraph receiving apparatus." T. N. Cole, R. P. Richardson, and G. L. Ward. February 6th.
3,563. "Rectifiers for alternating electric current." J. B. Bower. February 6th.
3,564. "Method of magnifying intermittent electric impulses." H. St. G. Anson. February 6th.
3,587. "Wireless loud-speaking telephone." E. R. Bates. February 7th.
3,591. "Methods of transmitting multiple alternating electric currents through separate cables for each phase." B. S. Hornby. February 7th.
3,617. "Fusible contacts for electric circuits." J. Schuil. February 7th.
3,624. "Electrically-heated water-boilers." H. Hargreaves and Jackson Boilers, Ltd. February 7th.
3,632. "Detachable handle for wireless, &c., apparatus." C. G. Millar. February 7th.
3,653. "Means for completing and breaking electric circuit." H. W. Hall and A. G. Kent-Johnston. February 7th.
3,654. "Electric illuminating devices, signs, &c." E. V. Hayes-Gratze. February 7th.
3,655. "Luminous electric signs, &c." E. V. Hayes-Gratze. February 7th.
3,661. "Dynamos and motors." M. W. W. Mackie. February 7th.
3,663. "Electric heating apparatus." J. R. Quain. February 7th.
3,664. "Lightning, &c., arresters for electric conductors." F. Coates and A. Reyrolle & Co., Ltd. February 7th.
3,668. "Wireless receiving apparatus." A. T. Jones and F. A. Pereira. February 7th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

3,158. "Electric rectifiers." P. Freedman. October 25th, 1921. (192,095.)
22,499. "High-voltage switch plant." Akt. Ges. Brown, Boveri & Cie. April 15th, 1921. (178,404.)
23,001. "Electric maximum automatic cut-out." D. J. B. Koolhaas. August 30th, 1920. (168,884.)
24,990. "Signalling apparatus for mines." A. Graham and A. Paton. September 21st, 1921. (192,114.)
25,493. "Apparatus for recording, reproducing, and amplifying sound." C. Blieberger. September 26th, 1921. (192,123.)
27,651. "Electric switches or contacts." Speedy & Lynon and P. Speedy. October 18th, 1921. (192,129.)
27,884. "Radio-signalling systems." British Thomson-Houston & Co., Ltd. (General Electric Co.). October 20th, 1921. (192,133.)
28,192. "Thermionic valves." H. St. J. de A. Donisthorpe. October 24th, 1921. (192,140.)
28,210. "Radio-transmitting systems." British Thomson-Houston Co., Ltd. (General Electric Co.). October 24th, 1921. (192,141.)
28,232. "Electro-therapeutic apparatus." C. M. Sanche. December 17th, 1920. (172,933.)
28,550. "Electrical circuit couplings." W. M. Barrington, W. E. Bottom, and M. H. Goldfard. October 27th, 1921. (192,160.)
28,696. "Arc generators of electric oscillations." H. M. Dowsett. October 28th, 1921. (192,171.)
29,116. "Means for audibly signalling upon sounds being reproduced in a telephone receiver." F. W. Hampshire. November 2nd, 1921. (Cognate application No. 1,339/22.) (192,183.)
29,140. "Batteries for miners' lamps and other like purposes." Three Star Accumulators, Ltd., and C. Kendall. November 2nd, 1921. (192,185.)
29,321. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 10th, 1920. (171,378.)
29,754. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). November 8th, 1921. (192,202.)
30,526. "Electric rivet-heating machines of the resistance type." J. W. Poole, W. J. Readett and Buckley, Saunders & Co. February 16th, 1922. (192,217.)
33,435. "Electric switches." A. E. McColl, C. C. Garrard, and A. H. Railing. December 13th, 1921. (192,247.)
34,675. "Method and apparatus for testing electrically-insulated wires." J. S. Mollerhoj. January 15th, 1921. (174,333.)
35,079. "Electric arc-light stage-lighting apparatus." A. Sernicoli and A. Anselmi. December 30th, 1921. (192,262.)

1922.

1,838. "Inductance coils for wireless telegraphy or other purposes." J. F. Sutton. January 21st, 1922. (192,272.)
2,934. "Electric switches." Cables Accessories Co., Ltd., F. H. Reeves, and P. W. Davis. February 1st, 1922. (192,280.)
3,201. "Telephone and signalling systems on electrical transmission lines." C. W. Kay and Callender's Cable & Construction Co., Ltd. February 3rd, 1922. (192,284.)
3,219. "Electro-magnetic relays." British L.M. Ericsson Manufacturing Co., Ltd., and W. M. Crowe. February 3rd, 1922. (192,285.)
3,461. "Protective means for electrical switchgear." A. H. Higgs and Ferranti, Ltd. February 6th, 1922. (Addition to 191,971.) (192,290.)
9,355. "Electric fuse wire holders." J. McGrath. March 31st, 1922. (192,320.)
10,216. "Junction between electric telephonic and like circuits." Soc. d'Etudes pour Liaisons Téléphoniques et Télégraphiques à Longue Distance. June 20th, 1921. (182,094.)
11,305. "Prepayment meter for gas, water, electricity, or similar commodities." Landis & Gyr Akt. Ges. April 21st, 1921. (178,858.)
11,592. "Electric horns and the like." Heinze Electric Co., B. Ames, and P. J. Gilinson. April 25th, 1922. (192,327.)
11,676. "Cooking and toasting attachments for electrical radiators." A. R. Dow. April 26th, 1922. (192,328.)
12,846. "Magnetic sound recording and reproducing apparatus." Vox Maschinen Akt. Ges. and Dr. W. Vogel-Sang. May 6th, 1922. (192,331.)
12,848. "Magnetic sound recording and reproducing apparatus." Telegraphie Ges. System Stille and Dr. C. Stille. May 6th, 1922. (192,332.)
12,862. "Multiple control apparatus for electric railways." Akt. Ges. Brown, Boveri et Cie. December 20th, 1921. (190,435.)
13,782. "Sparking plugs for internal-combustion engines." H. E. Holloway. May 16th, 1922. (192,334.)
14,887. "Apparatus for winding up a spring motor by hand and by an electromotor." Allgemeine Elektricitäts Ges. May 27th, 1921. (180,690.)
16,491. "Telephone systems." Siemens and Halske Akt. Ges. July 15th, 1921. (183,116.)
17,932. "Electric blasting primers and the manufacture thereof." Etablissements Davey, Bickford, Smith et Cie. January 30th, 1922. (192,338.)
27,001. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. November 3rd, 1921. (Divided application on 171,378.) (Addition to 171,378.) (192,342.)
29,121. "Circuit breakers." P. G. van Wijk. October 26th, 1921. (187,974.)
34,655. "Wireless signalling receiving systems." British Thomson-Houston Co., Ltd. (General Electric Co.). September 30th, 1921. (Divided application on 191,125.) (192,346.)